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Philippine Resins, Gums, Seed Oils, and Essential Oils. Department of Agriculture and Natural Resources, Bureau of Forestry Bulletin #20. By Augustus P. West, and William H. Brown. 1920.

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EMANUEL FRITZ

UNIV. OF CALIFORNIA

REGULATIONS

GOVERNING THE

UTILIZATION OF FOREST PRODUCTS

OF

STATE LANDS.

MANILA:
BUREAU OF PUBLIC PRINTING.
1903.

3030

UNIV. OF CALIFORNIA

OFFICE OF THE UNITED STATES MILITARY GOVERNOR IN THE PHILIPPINE ISLANDS.

MANILA, P. I., *June 27, 1900.*

GENERAL ORDERS }
No. 92. }

The following provisions, based on existing law, and amendatory thereto, prescribing the tariff on State timber, and regulations for the utilization of forest products in the public forests of the Philippine Islands, shall have the force and effect of law on and after July 1, 1900, but existing law on the same subjects shall remain valid, except in so far as herein modified or repealed, expressly or by necessary implication.

CHAPTER I.

TARIFF ON STATE TIMBER AND INSTRUCTIONS FOR ITS APPLICATION.

ARTICLE 1. Timber shall be classified into six groups, as indicated in the tables below.

ART. 2. The unit of measure shall be, for the present, the cubic foot. It is recommended that lumber dealers accustom their employees to the use of the metric system.

ART. 3. The price per cubic foot for the valuation of State timber shall be as indicated in the following table. The price shall be the same in all parts of these islands:

	Cents (Mex.).
Superior group, per cubic foot	14
First group, per cubic foot	10
Second group, per cubic foot	8
Third group, per cubic foot	3
Fourth group, per cubic foot	2
Fifth group, per cubic foot	1

ART. 4. The State sells its trees standing, excluding the bark in measuring the tree.

Art. 5. Inasmuch as the measurement of standing timber can not always be made, for lack of available forestry employees, the concessioners may stack the timber hewn, or cut up, subject to the additional charges hereinafter provided.

Art. 6. In round timber the length of the piece and the circumference in the middle section shall be measured.

Art. 7. When the logs are presented rough hewn, i. e., where a section is approximately octagonal (four sides being hewn and the other four with the bark on), the dimensions shall be taken by measuring the length and average transverse section, but said section shall be a quadrilateral, formed by prolonging the four larger sides, i. e., the four hewn sides.

Art. 8. If the logs be hewn square, the contents shall be ascertained by measuring the length and an average transverse section, but in such cases the valuation shall be increased twenty-five per cent for the wood lost in hewing the tree square.

Art. 9. The cubic contents of sawed timber shall be ascertained as in the preceding article, carrying out the figures to tenths of a cubic "point"; but the increase in valuation (to make up for loss in the sawing) shall be limited to fifteen per cent.

Art. 10. Wood of the Camagon tree, when presented stripped of its inner bark or surplusage, using only the heart wood, as is the custom of the trade, shall be measured according to the cubic contents actually presented, but the valuation shall be increased one hundred per cent.

Art. 11. Logs of ebony trimmed down in like manner to the black hard-wood shall be measured according to the cubic contents actually presented, as in the preceding case, but the valuation shall be increased two hundred per cent.

Art. 12. The woods of Groups three, four, and five only may be cut for fuel.

Art. 13. Classification of woods as per first article:

I. Superior Group.

No.	Popular names.	Scientific names.
1	Calantas	Cedrela toona, Roxb.
2	Camagon	Diospyros discolor, Willd.
3	Dungon	Heritiera silvàtica, Vidal.
4	Ebano	Maba buxifolia, Pers.
5	Ipil	Afzelia bijuga, A. Gray.
6	Mancono	Xanthostemon verdugonianus, Naves.
7	Molave	Vitex altissima, Linn.
8	Narra	Pterocarpus indicus, Willd.
9	Teca	Tectona grandis, Linn.
10	Tindalo	Afzelia rhomboidea, Vidal.
11	Yacal	Hopea plagata, Vidal.
12	Urung	Fagraea fragans, Roxb.

II. First Group.

No.	Popular names.	Scientific names.
1	Acle	Pithecolobium acle, Vidal.
2	Alahan	Diospyros.
3	Camphor	Cinnamomum camphoratum, Blume.
4	Alintatao	Diospyros.
5	Anubing	Artocarpus ovata, Blanco.
6	Bansalaguin	Mimusops parvifolia, R. Br.
7	Baticuling	Litsea perrottetii, Benth. & Hook.
8	Batitinan	Lagerstroemia batitinan, Vidal.
9	Bayuco	Artocarpus nitida, Trec.
10	Betis	Azaola betis, Blanco.
11	Camuning	Murraya exotica, Linn.
12	Cubi	Artocarpus cumingiana, Trec.
13	Jara	Garcinia sp.
14	Lanete	Wrightia ovata, A. DC.
15	Malatapay	Alanguium octopetalum, Blanco.
16	Calamansanav	Terminalia calamansanai, Rolfe.
17	Camayuan or Tamayuan.	Gymnosporia.

III. *Second Group.*

No.	Popular names.	Scientific names.
1	Agoho	Casuarina equisetifolia, Linn.
2	Alalangat	Adenanthera pavonina, Linn.
3	Alpay	Nephelium glabrum, Noronch.
4	Alupac-amo	Nephelium longana, Cambess.
5	Amuguis 1st	Odina speciosa, Blume.
6	Aranga	Homalium barandæ, Vidal.
7	Banaba	Lagerstrœmia flos-reginæ, Retz.
8	Banitan	Xylopia blancoi, Vidal.
9	Batino	Alstonia macrophylla, Willd.
10	Bayuco 2d	Artocarpus sp.
11	Banuyo	Albizzia sp.
12	Bilolo	Eugenia sp.
13	Bolong eta	Diospyros pilosanthera, Blanco.
14	Calimantao	Evodia sp.
15	Calingag	Cinnamomum mercadoi, Vidal.
16	Caña fistula	Cassia fistula, Linn.
17	Catmon	Dillenia philippinensis, Linn.
18	Dolitan	Palaquium sp.
19	Dungon-late	Heritiera littoralis, Dryand.
20	Guijo	Anisoptera guiso, A. DC.
21	Guipato	?
22	Guisihan	Ratonia montana, Benth. & Hook.
23	Lanutan	Thespesia campylosiphon, Rolfe.
24	Macaasin	Eugenia sp.
25	Madre cacao	Glirisidia maculata, H. B. K.
26	Malacadios	Myristica sp.
27	Malacapon	?
28	Malacatmon	Dillenia reiffercheidia, Villar.
29	Malaruhat	Eugenia sp.
30	Mangachapuy	Shorea mangachapoi, Blume.
31	Mangasinoro	Shorea sp.
32	Mangasirique	Quercus sp.
33	Marang	Artocarpus sp.
34	Mulauin aso	Premna nauseosa, Blanco.
35	Nangca	Artocarpus integrifolia, Linn.
36	Nato	Sterculia sp.
37	Oayan	Quercus blancoi, A. DC.
38	Paitan	Eugenia sp.
39	Palayen	Quercus sp.
40	Palo Maria	Calopyllum inophyllum, Linn.
41	Pasac	Pygeum arboreum, Endl.
42	Pusopuso	Listea chinensis, Lam.

III. Second Group—Continued.

No.	Popular names.	Scientific names.
43	Romero	Podocarpus costalis, Presl.
44	Sirique	Quercus sp.
45	Supa	Sindora wallichii, Benth.
46	Tanguile	Shorea talura, Roxb.
47	Toob or Tua	Biscopia javanica, Blume.
48	Tucan-calao	Sterculia sp.

IV. Third Group.

1	Abilo	Garuga floribunda, Decne.
2	Alagao	Premna vestita, Schauer.
3	Alamag	Aporosa sp.
4	Aclen parang	Albizzia sp.
5	Anagap	Pithecolobium lobatum, Benth.
6	Aninapla	Albizzia procera, Benth.
7	Anobling	Talauma angatensis, Vidal.
8	Anonang	Cordia myxa, Linn.
9	Anatan	Brackenridgea fascicularis, Villar.
10	Apitong	Dipterocarpus grandiflorus, Blanco.
11	Bagarilao	Nauclea.
12	Bagarilao na itim	Terminalia sp.
13	Baguilumboy	?
14	Bahay	Ormosia calavensis, Azaola.
15	Balinhasay	Buchanania florida, Schauer.
16	Balobo	Diplodiscus paniculatus, Turcz.
17	Balucanta	Aleurites triloba, Forst.
18	Banitan	Xylopia blancoi, Vidal.
19	Balete	Wrightia sp.
20	Batobato	Litsea sp.
21	Bayabas	Psidium guyabas, Linn.
22	Bayoc	Pterospermum acerifolium, Willd.
23	Bitoc	Calophyllum sp.
24	Bunglas	?
25	Calumpit	Terminalia edulis, Blanco.
26	Camanchiles	Pithecolobium dulce, Benth.
27	Cansuyot	Antidesma sp.
28	Cunalong	Diospyros sp.
29	Cupang	Parkia roxburghii, G. Don.
30	Dalindigan	Shorea sp.
31	Dalinsin	Terminalia sp.
32	Danglin	Grewia multiflora, Juss.

IV. Third Group—Continued.

No.	Popular names.	Scientific names.
33	Dao	Dracontomelon.
34	Dinglas	Eugenia sp.
35	Ditaa	Alstonia scholaris, Linn.
36	Duclap	Zizyphus sp.
37	Duguan	Myristica fatua, Houtt.
38	Galagala	Agathis lorantifolia, Salisb.
39	Gatasan	Garcinia sp.
40	Guyonguyon	Cratoxylon floribundum, Villar.
41	Hagadhad	Dipterocarpus pilosus, Roxb.
42	Lauan	Anisoptera thurifera, Blume.
43	Libato	Cumingia philippinensis, Vidal.
44	Lucban gubat	Citrus sp.
45	Lunbang	Aleuritis sp.
46	Magarapale	Terminalia sp.
47	Magarilao	Terminalia sp.
48	Malaanonang	Dipterocarpus sp.
49	Malabayabas	Gardenia pseudopsidium, Blanco.
50	Malacadios	Myristica sp.
51	Malacmalac	Palaquim sp.
52	Malasaguin puti	Eugenia sp.
53	Mamalis	Pittosporum brachysepalum, Turcz.
54	Manbog	Stephegyne diversifolia, Hook.
55	Manga	Mangifera indica, Gaertn.
56	Manungal	Samadera indica, Gaertn.
57	Matabao	?
58	Mayapis	Dipterocarpus sp.
59	Pagatpat	Sonneratia acida, Linn.
60	Pagsainguin	Canarium cumingii, Engl.
61	Palosapis	Shorea sp.
62	Paho	Mangifera altissima, Blanco.
63	Pili	Canarium ovatum, Engl.
64	Panao (Balao)	Dipterocarpus hispidus, Villar.
65	Pipi	Litsea garciæ, Vidal.
66	Pulanbalat	Syzygium sp.
67	Quinay-Quinay	Bridelia sp.
68	Sacat	Terminalia sumatrana, Miq.
69	Saleng	Pinus insularis, Endl.
70	Sampaloc	Tamarindus indicus, Linn.
71	Tabigui	Carapa moluccensis, Lam.
72	Talisay	Terminalia catappa, Linn.
73	Tapulao	Pinus merkusii, Jungh. & Vriese.
74	Taquitaqui	?
75	Tunbon aso	Morinda umbellata, Linn.

V. Fourth Group.

No.	Popular names.	Scientific names.
1	Agos-os	Ficus pungens, Reinw.
2	Agupanga	Chisocheton sp.
3	Alauihao	Dracontomelon sp.
4	Alasas	Ficus hirta, Vahl.
5	Amugan	Pygeum maingayi, Hook.
6	Amuyon	Melodorum fulgens, Hook. and Thoms.
7	Anam	Buchanania nitida, Engl.
8	Anilao	Columbia anilao, Blanco.
9	Aroma	Acacia farnesiana, Willd.
10	Asactalon	Phyllanthus sp.
11	Asis	Ficus heterophylla, Linn.
12	Ata-ata	
13	Bacan	
14	Bacodong	
15	Bagaluga	Melia dubia, Cav.
16	Bagonito	Cupania sp.
17	Bagontao	
18	Bago-santol	
19	Bait	Canarium sp.
20	Balacat	Zizyphus sp.
21	Balasabis	Cupania regularis, Blume.
22	Balay-bayan	Pterospermum diversifolium, Blume.
23	Balay-ohot	
24	Balibago	Hibiscus tiliaceus, Linn.
25	Baligamban	
26	Balinaonao	Capura sp.
27	Baloc	Sapindus sp.
28	Baloc baloc	Pongamia glabra, Vent.
29	Baluan	Marcaranga sp.
30	Balubat	Anacardium sp.
31	Balucot	Garcinia cowa, Roxb.
32	Ballan ballan	Leea sp.
33	Banaguling	
34	Banalo	Cordia subcordata, Lam.
35	Banato	Mallotus philippinensis, Muller.
36	Bancalauan	Terminalia sp.
37	Bancudo or Nino	Morinda bracteata, Linn.
38	Bangate	
39	Bang-got	
40	Bani	
41	Batingui	Pemphis sp.
42	Barinconcoron	

V. *Fourth Group*—Continued.

No.	Popular names.	Scientific names.
43	Barusa	
44	Batang-hisan	
45	Batican	Dracontomelon sp.
46	Bating	
47	Batsan	Dracontomelon sp.
48	Bausio	
49	Bayac-usa	Orchipeda sp.
50	Bayit	Jambosa sp.
51	Biga	Zizyphus sp.
52	Bigas	
53	Bignay	Antidesma bunius Spreng.
54	Bignay-calabao	Antidesma ghesæmbilla, Gaertn.
55	Bilaun	Macaranga mappa, Mueller.
56	Bilucao	Garcina sp.
57	Binayuyo	Antidesma cumingii, Mull.
58	Binting-dalaga	Micromelum sp.
59	Binunga	Macaranga tanarius, Mull.
60	Boc-boc	Streblus sp.
61	Bogo	Garuga sp.
62	Boto-buti	
63	Botong	Barringtonia speciosa, Linn.
64	Bubuy	Eriodendron anfractuosum, DC.
65	Cabong-cabong	
66	Cabuyao	Citrus hystrix, DC.
67	Cacao-cacauan	Talauma sp.
68	Cagatungan	Pygeum wightianum, Blume.
69	Calay	Xylopia sp.
70	Caliang-tang	Leea sambucina, Willd.
71	Caloc-catmo	Vidalia sp.
72	Calumpang	Sterculia foetida, L.
73	Cami-oi	
74	Canomay	Diospyros sp.
75	Caraol	Acacia sp.
76	Caropsan	Linociera luzonica, Villar.
77	Carumanpat	
78	Caturay	Sesbania grandiflora, Pers.
79	Cugao	
80	Culin-manog	Canthium mite, Benth.
81	Culis	Memecylon edule, Roxb.
82	Cuyaquia	Prometia sp.
83	Cuyas-cuyas	
84	Daluroy	Aglaia argentea, Blume.

V. *Fourth Group*—Continued.

No.	Popular names.	Scientific names.
85	Dangle	
86	Daniri	Euphorbia sp.
87	Danloy	Grewia sp.
88	Danyay	
89	Dapdap	Erythrina indica, Lam.
90	Dila-dila	
91	Dilang butiqui	
92	Dondonay	
93	Duca	Dittelasma sp.
94	Dumpilan	
95	Himbabao	Excœcaria agallocha, Linn.
96	Hongo	Eleocarpus sp.
97	Hopong-hopong	
98	Hugud	
99	Kugao	
100	Lagasa	
101	Lagnig	Clausena sp.
102	Lamio	Dracontomelon mangiferum, Blume.
103	Leptasao	
104	Libas	Eugenia sp.
105	Ligaa	
106	Ligas	Semecarpus anacardium, Linn.
107	Lipote	Eugenia sp.
108	Lubtob	Ficus sp.
109	Lunas	Lunasia amara, Blanco.
110	Lunas-na-itim	Gonocaryum tarlacense, Vidal.
111	Llapa	
112	Maata	
113	Macaturay	Stereospermum sp.
114	Maga	
115	Magabagaba	
116	Magarambulo	Cyclostemon sp.
117	Maguilic	Litsea sp.
118	Malaaduas	
119	Malabago	Hibiscus sp.
120	Malabonga	Iteadaphne confusa, Blanco.
121	Malabulac	Bombax malabaricum, DC.
122	Malacacao	Talauma sp.
123	Malacamote	Beddomea luzoniensis, Vidal
124	Malacauayan	Hemegyrosa deficienis, Bed.
125	Malacna	Clethra canescens, Reinw.
126	Malaga-api	

V, *Fourth Group*—Continued.

No.	Popular names.	Scientific names.
127	Malaga-itiman	
128	Malaiba	Phyllanthus sp.
129	Malaicmo	Celtis philippinensis, Blanco.
130	Malanbang	Mallotus sp.
131	Malang-dalaga	
132	Malapalitpit	Sapindus turczaninowii, Vidal.
133	Malapapaya	Panax cumingianum, Rolfe.
134	Malasamat	
135	Malasambong	Vernonia arborea, Ham.
136	Malasanqui	Cinnamomum sp.
137	Malasantol	Sandoricum borneense, Miq.
138	Malatagon	Canarium sp.
139	Malatigui	Albizzia sp.
140	Malatubic	Sizygium sp.
141	Malauban	Barringtonia sp.
142	Manay	
143	Matan-cuao	
144	Malibog	
145	Matobato	
146	Matungoc	
147	Mauayan	
148	Nanagdong	
149	Oonog	Albizzia julibrissin, Durazz.
150	Orihnon	
151	Paihot	Mangifera sp.
152	Palang	Acalypha sp.
153	Pamalataguen	Canthium sp.
154	Pandacaqui	Tabernæmontana coronaria, Willd.
155	Pangilinon	Wormia sp.
156	Payaquitan	
157	Pingol	Englehartia sp.
158	Postalagon	Gomphia angustifolia, Vahl.
159	Pototan	Ceriops candollanea, Arn.
160	Pugauy	Nelitris sp.
161	Puray	
162	Putad	Barringtonia recemosa, Blanco.
163	Quiniang	
164	Quio	Ardisia sp.
165	Rubian	
166	Sagum-sagum	
167	Salab	Cupania sp.
168	Salamungay	Aglaia sp.

V. *Fourth Group*—Continued.

No.	Popular names.	Scientific names.
169	Salasic	
170	Salingogon	
171	Sipit-Cait	
172	Subian-daga	Plectronia sp.
173	Subo-subo	
174	Sulipa	Gardenia sp.
175	Supi	
176	Surug	
177	Susuguin	
178	Tabaldo	
179	Tabao	
180	Tabayos	
181	Taboc	Aegle decandra, Villar.
182	Tadcan	
183	Taliganan	Pterospermum sp.
184	Talio	
185	Tambis	Eugenia sp.
186	Tanag	Kleinhovia hospita, Linn.
187	Tanglon	Amoora sp.
188	Taquit-asim	Mallotus moluccanus, Mull.
189	Tayocan	
190	Tical	Aglaia sp.
191	Tinaan	Phyllanthus sp.
192	Tinaan-pantay	
193	Tingan	
194	Tinga-tinga	Pterospermum obliquum, Blanco.
195	Tincal	Aglaia sp.
196	Tive-tive	
197	Toquian	Ternstroemia toquian, Vidal.
198	Tua	Dolichandrone rheedii, Linn.
199	Tulang-manog	
200	Uban	Premna sp.

VI. *Fifth Group.*

1	Bacao	Rhizophora conjugata, Linn.
2	Bacauan	Bruguiera caryophyllaeoides, Blume.
3	Biuas	Kandelia rheedii, W. & A.
4	Bungalon	Avicennia officinalis, Linn.
5	Calibayoan	Bruguiera eriopetala, W. & A.

VI. Fifth Group—Continued.

No.	Popular names.	Scientific names.
6	Culasi	Lumnitzera racemosa, Willd.
7	Langaray	Bruguiera parviflora, W. & A.
8	Libato-pula	Lumnitzera coccinea, W. & A.
9	Libato-puti	Cumingii philippinensis, Vidal.
10	Nilad	Scyphiphora hydrophyllacea, Gaertn.
11	Tagasa	Ceriosps roxburghiana, Arn.
12	Tangal	Rhizophora mucronata, Lam.
13	Tingan-baquis	Ægiceras majus, Gaertn.

PALMS.

No.	Popular names.	Scientific names.
14	Anahao	Livinstona rotundifolia, Mart.
15	Anibong	Areca nibung, Mart.
16	Balatbat	Licuala sp.
17	Balon-luyon	Corypha sp.
18	Banga	Wallichia sp.
19	Barangoy	Orania sp.
20	Bonga	Areca catechu, Linn.
21	Cauon	Arenga saccarifera, Labill.
22	Dayuca	Wallichia sp.
23	Dumayaca	Caryota sp.
24	Lumbiac	Iguanura.
25	Luyos	Areca sp.
26	Macasilad	Licuala elegans, Mart.
27	Palindan	Bentinckia sp.
28	Pinag	Areca alba Rumph. var. genocarpa, Kunth.
29	Pugahan	Caryota urens, Linn.
30	Saguisi	
31	Tamis-san	Cocos sp.
32	Taquipan	Caryota rumphiana, Mart.
33	Tibanglan	

Chapter II.

THE UTILIZATION OF TIMBER IN THE STATE FORESTS.

Art. 14. One year from the date of license shall be allowed for the felling and removal of timber. When the time allowed is not sufficient to admit of this, an application for a new license must be made, within such time as will admit the issuing of the same before the expiration of the legal limit of the old license.

Art. 15. Felled timber shall be piled in cleared places, in such a manner that measurements may be readily ascertained.

Art. 16. The concessioner shall advise the chief of the forest section of the time the cutting will commence; shall state in what jurisdiction it will be effected, the places where the timber will be piled, and the names and residences of his representatives.

Art. 17. No concessioner holding a license for the ordinary cutting of wood shall be allowed to act, at the same time, for a concessioner holding a gratuitous license.

Art. 18. The concessioner, having cut the wood, shall be held responsible by the State for its value, as per official tariff. If, at the expiration of the time of his license, he has not taken the timber out of the forest, in addition to its value he will be held responsible for any damages which may have resulted, to be estimated and approved by the forestry official of the district.

Art. 19. The carrier of sawed lumber, transporting same from lumber yards or private warehouses, must be provided with a receipt, signed by the owner of the establishment from which it came, showing in detail the number and classes of the pieces. These receipts will be shown to the forestry officials, when asked for, in order to show where the lumber came from, and avoid confusing same with products which are carried direct from the public forests.

Art. 20. Constructors of vessels shall procure licenses and pay the value of the timber used, and must furnish the local forest official with a statement of the timber cut, which statement said official verifies.

Art. 21. After inspectfon and valuation of timber is made, the order of payment is given, and after said payment is made and receipt shown, the concessioner is free to use the timber.

Art. 22. No vessel, whatever its size, built of timber from the public forests, can put to sea without having paid for the timber used, except as provided in the regulations governing the gratuitous use of timber.

Art. 23. 1. Owners of mining concessions must pay an annual rent or tax for the ground so occupied, which tax shall be regulated by the greater or less adaptability of the ground to the purposes of forest or agricultural cultivation. A bond of a sufficient amount shall also be required to cover any damage which may happen to the trees or forest products from said mining operations, the conditions to be fixed by this office, after due notice.

2. Owners of mining concessions, or their legal representatives, shall procure from this office a license before utilizing State timber in their mining operations.

3. Applications for said licenses shall be forwarded through the Mining Bureau, in which application shall be described the mining concessions they possess or represent, the forest or forests in which the timber is to be cut, the kinds of woods desired, and the approximate quantity, also the uses to which the timber is to be put.

Art. 24. 1. Those who may desire to engage in the business of burning charcoal in the public forests shall comply with the forestry regulations in everything which relates to the utilization of the forest products, and must provide themselves with the necessary licenses.

2. After felling trees, and before commencing the process of burning for charcoal, the party interested shall present to the local forestry official an itemized statement of the timber felled, which will be verified and valued by that official, who will give the order of payment. After payment, the party is at a liberty to proceed with the burning, exercising care to do so at a sufficient distance from standing timber so as not to cause damage, and he shall be held responsible for any damage so caused.

Art. 25. Concessioners shall notify the local forestry official, or, in his absence, the president of the respective town, where the wood is being piled. Upon failure to do so as prescribed, a penalty will be incurred of twenty-five per cent of the value of the wood.

Art. 26. Constructors of vessels and charcoal burners who fraudulenty report to the forestry official the number of pieces of wood cut will pay, in addition to the value of the excess, a fine of twenty-five per cent of its value.

Chapter III.

THE GRATUITOUS USE OF STATE TIMBER.

Art. 27. 1. Licenses for the free use of timber shall be issued without charge by this office.

2. Said licenses shall be issued to needy residents of towns, upon application, to which application shall be attached a certificate signed by the president or alcalde of the town, stating the circumstances and actual need in each particular case; no charge shall be made for this certificate.

3. Said timber must be used exclusively in the construction of houses in which the parties making application are going to live, or have place of bussines, or for repair of same, for the manufacture of their implements of industry; in the construction of one or two bancas for the purpose of fishing, or for the transportation of their agricultural products.

4. The amount of timber thus conceded to needy residents by gratuitous license shall not exceed one thousand cubic feet.

Art. 28. Tree species of the superior and first groups, as laid down in the official tariff on State timber, are not to be cut under a gratuitous license.

Art. 29. Timber for the construction of bridges, Government buildings and other works of a public character undertaken by the Government may be obtained by gratuitous license issued by this office, application being made by the proper official.

Art. 30. Needy residents, and those persons in charge of the construction of public works, desiring licenses for the gratuitous use of State timber, shall send their applications, with other documents, to the chief forestry official of the district or section, and in case there is no such official available, to the district commander, who will forward same with the necessary indorsements, to this office.

Art. 31. When the work referred to in article 29 is done by contract the contractor must procure an ordinary license, and comply with all the requirements of same.

Art. 32. Six months from date of license shall be allowed needy residents in which to fell and remove said timber. One year from date of license for such purpose shall be allowed persons engaged in the construction of public works. When there is not sufficient time in which to finish said work, a new license should be solicited in time so that it may be issued before the expiration of the old license.

Art. 33. There shall be attached to applications for gratuitous licenses to cut timber for public works a statement of the number of pieces, classes, and dimensions of the wood required.

Art. 34. A concessioner shall notify the chief forestry official of the respective section of the time and place of cutting, and where the timber is to be stacked, and the location of the public works for which the timber was granted.

Art. 35. A gratuitous license shall not be issued to timber dealers nor to those holding an ordinary license.

Art. 36. The concessioner, after cutting is finished, shall notify in writing the chief of the forest section, inclosing a statement of the timber cut.

Art. 37. Timber can not be taken out of the jurisdiction of the town where cut unless accompanied by a manifest authenticated by the local forestry official, or, in his absence, by the president of the town (no charge shall be made for this authentication). The concessioner shall, as pêr foregoing article, remit this manifest to the forestry official of the section, after said timber has arrived at the location of above-mentioned public works. Said timber shall be detained in case of failure to show a proper manifest, and, in addition, a fine of from one to five per cent of the value of the wood so detained shall be imposed.

Art. 38. The chief forestry official of the forestry section, or the ranger of the precinct, shall see that the cutting is carried on in conformity with these regulations and terms of license. He shall compare the statements received from the concessioner and inspect and measure the wood piled, or used, in said public works.

Art. 39. The concessioner shall be considered, as per Article 30 of these regulations, as an appointee of the district commander, or other competent authority, and also as his representative in the execution of said public work, and shall be held personally responsible for any violation of these regulations.

Art. 40. The concessioner is prohibited from giving away or selling a single piece of wood cut under this form of license, not even under the pretext that it is surplus wood. The wood must be used for the purpose for which it was granted, and should there be any surplus, said surplus shall be deposited in the presidencia of the town at the order of the chief of the forest section, who will immediately arrange for its sale at public auction. In such a case the concessioner shall have no right to indemnity of any character, not even for expense of felling, hewing, or transportation, etc.

Art. 41. Should any persons with a proper license for cutting timber for his personal and exclusive use or for public work, cut a greater quantity than is allowed in said license, or takes different classes from those specified, or applies them to a different object than that stated by the concessioner, or speculates in them, shall pay the value of the timber, and, in addition, a fine of three times its value.

Art. 42. Presidents or alcaldes of towns shall carefully attend to all who desire certificates referred to in the twenty-seventh article, and shall exercise care not to make any false statements as to the needs of the applicants, under a penalty of $20 fine for the first offense, and an indictment before the courts in case of repetition.

Art. 43. Concessioners of gratuitous licenses, shall notify the local forest official, or, in this abense, the president or alcalde of the town, of the different places where the wood is being piled. Failure to do so shall render concessioner liable to a fine equal to twenty-five per cent of the value (as per official tariff) of the wood so piled.

Chapter IV.

FIREWOOD FOR THE MARKET.

Art. 44. 1. Licenses to cut firewood for the market, to be cut in the State forests, shall be issued from this office.

2. Applications for said licenses shall be delivered to the chief of the forest district or section, who will forward same to this office with the necessary remarks.

3. District commanders may issue such licenses, after having received the proper information concerning the circumstances of each particular case from the chief of the forest section of the locality where the wood is to be cut.

4. District commanders shall notify this office, and also the chief forestry official of the province, of the number of licenses issued by their order.

5. One year from date of license shall be allowed for the cutting, splitting, and removal of firewood.

6. When said period is not sufficient, a new license shall be solicited in time to allow of its issue before the expiration of the old license.

Art. 45. The tree species of the third, fourth, and fifth, groups only can be used for firewood, and those cutting other species shall render themselves liable to a fine of four times the value of the wood, which shall be measured and valued as timber, as per official tariff.

Art. 46. When there is a great amount of firewood cut, the concessioner shall localize his cutting and pile the wood beyond the forest, to avoid danger of fire when wood becomes dry.

Art. 47. When the forest consists of dead and dry timber as a result of fire, all may be cut down, but if the forest is composed of live trees, those to be cut must be selected and cut down close to the ground. In falling; care must be taken that the adjacent standing trees are not injured.

Art. 48. When it is not convenient for the concessioner to pay the value of the products utilized in the office of the internal revenue of the province, on account of its distance from the place of cutting, payment may be made to the president or alcalde of the nearest town, who shall receive the amount, give a receipt to the concessioners and send a copy of this receipt to the nearest forestry official.

The sums thus collected by presidents or alcaldes shall be turned into the office of internal revenue.[1]

Art. 49. The concessioners shall notify the local forestry official, or, in his absence, the president of the town where the wood is being piled; if said notice is not properly given a fine of twenty-five per cent of the value of the firewood shall be imposed.

Art. 50. 1. Firewood cut in the forests of the State shall be divided into two classes.

The first class, whether pieces are round or split, is known in the market under the name of "rajas," from seventy-five centimeters to one and one-half meters long, and from twenty to forty centimeters in circumference.

2. All firewood in small sticks not of these dimensions belong to the second class.

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[1] Act No. 82 of the Civil Commission, enacted January 31, 1901, entitled "The Municipal Code," section 21, reads: "The municipal treasurer shall receive all moneys paid to the municipality from any source."

ART. 51. All pieces exceeding the maximum dimensions fixed for firewood shall be designated as timber, paid for by cubic feet, as per official tariff.

ART. 52. 1. Firewood of the first class, destined for home consumption, shall be charged for at the rate of one dollar per thousand "rajas," and when intended for export at the rate of two dollars per thousand "rajas."

2. Firewood of small size, belong to the second class, destined for home consumption, shall be charged for at the rate of twenty cents per cubic meter, and when intended for export at the rate of forty cents per cubic meter.

Proportional charge will be made for fractions of a thousand of cubic meter.

CHAPTER V.

CAOUTCHOUC, GUM ELASTIC, GUTTA-PERCHA, GUM MASTIC, RESIN (BLACK AND WHITE), AND BALAO.

ART. 53. One year from date of license shall be allowed for the harvesting of this class of products; when said period of time is not sufficient, a new license shall be solicited in time to allow its issue before the expiration of the old license.

ART. 54. 1. In extracting these products the concessioner shall make cuttings or incisions into the trunks of the trees at least twenty-five centimeters above the ground. The felling of said trees without permission is absolutely prohibited.

2. These incisions should be made with a very sharp instrument, penetrating the bark and the first layers of wood.

3. The incisions shall be cut horizontally and twenty-five centimeters in length.

4. When the flow of the juices is obstructed at the opening, the concessioner will be permitted to recut the outer edges, and to enlarge the incision or cutting by twenty-five centimeters, prolonging it upward.

5. In those trees which have trunks measuring more than forty centimeters in diameter (approximately one and a half feet), the concessioner will be permitted to make four incisions or cuttings on opposite sides.

6. The width of the cutting shall never exceed eight centimeters.

7. A metal or wooden plate may be placed on the lower part of

the incision to facilitate the collection of the juice. A vessel may be placed under the incision at the foot of the tree.

ART. 55. From the flowering of the tree to the ripening of its fruit, trimming of the edges of said incisions, or any lengthening of the same, shall not be permitted.

ART. 56. Said products may be stored in towns, wards, or other places, at the convenience of the concessioner, having previously notified the chief forestry official of the section, or, in his absence, the nearest local authority, in order that the proper legal formalities may be followed.

ART. 57. 1. A manifest shall accompany said forest products when transported from one place to another within the same province. Said manifest shall be made out by the chief forestry official of the section or locality; in his absence, by the president or alcalde of the town; or if destined for another province, by the nearest local commander. If the manifest is made by a president, there shall be stated in it the class and weight of each class of products to be removed; but if the manifest is made by the chief forestry official of the section, or, in his absence, by the nearest local commander, there shall also be stated the value of each class of said products.

2. The forest official at point of destination of products has the right to verify the correctness of the manifest or letter of payment which accompanies said products. If any difference should be found between the amounts shown on said documents, and the actual amount of cargo, the concessioner shall pay the amount of excess, and if said excess should be more than the fifth part, shall also incur a fine of twice the value of said excess.

ART. 58. Concessioners utilizing this class of products shall, for the present, pay ten per cent of its value, as per market price in Manila at time of inspection and measurement.

CHAPTER VI.

GENERAL PROVISIONS.

ART. 59. 1. Licenses to gather or utilize forest products in the State forests shall be granted by this office.

2. Applications for said licenses must be delivered to the chief forestry official of the forest district or section, or to the district

commander, who shall forward same to this office with the necessary indorsement of the forestry official of said district. In the application shall be stated the kinds of forest products desired and the place where said products are to be gathered.

3. The gathering or utilization of forest products can be done only in the forests of the province specified in the license. If the concessioner should cut or gather forest products in the forests of any other province, said products shall be considered as unlawfully cut.

4. No charge shall be made for licenses nor for the authentication or making out of manifests.

5. Reserved forests and the species of trees, the cutting of which is forbidden, will be noted in licenses for the information of the concessioner. The felling of trees of the superior and first groups, excepting ebony, camuning, and lanete, of a less diameter than forty centimeters is absolutely prohibited.

6. The felling in the State forests of trees, from which caoutchouc, gutta-percha, and gum elastic are extracted, is prohibited.

The following is a partial list of names of the above-mentioned tree species:

Agiotin,	Dysoxylum.
Anocep,	Palaquium.
Antipolo,	Artocarpus incisa, Li.
Palacpalac,	Palaquium latifolia, Bl.
Balete,	Urostigma sp.
Camansi,	Artocarpus Camansi.
Malaputad,	Palaquium sp.
Tanguisan,	Ficus sp.
Tanguisan baguio,	Ficus.
Tanguisan Bayaba,	Ficus cuneata, Mig.
Tibig,	Ficus heterophylla L.

7. The felling in the State forests of the ylang ylang tree is prohibited.

8. The utilization of forest products not specifically mentioned in these regulations shall be by license, and said utilization shall be governed by special conditions which may be ascertained upon presentation of application for a license to utilize said products.

Art. 60. Whosoever cuts or removes timber or other forest products prohibited by official order, or cuts species, the utilization of which is prohibited by special mention in the license, shall incur a penalty amounting to four times the value of the products. A copy of these regulations shall accompany each license.

ART. 61. The concessioner must gather said forest product together and pile it in the district where cut or gathered, and not where the cutting of timber or other utilization of forest products is forbidden. For any violation, he shall incur a penalty of four times the value of the product gathered.

ART. 62. 1. The trees to be cut shall be selected and cut down close to the ground, care being taken that no damage be done, in falling, to the adjacent trees. The concessioner shall compactly pile the branches of all trees felled, and place said branches where the least damage shall be done to the younger growth.

2. Forest products shall be transported as far as possible by routes where there are few trees, avoiding as far as practicable the destruction of the younger growth.

3. Concessioners shall be held responsible for any damage to the forests, through failure to comply with the above requirements. They shall also be held responsible for violations of said regulations on the part of their representatives or their employees.

ART. 63. When the cutting or gathering of forest products has been finished, the concessioner shall notify in writing the nearest forestry official of the place where said product is deposited, the classes and amount of the same, and its destination.

He shall also state if he has left any felled timber in the forest, and if so, the number of trees and the classes.

A forestry official shall verify the "statement" of forest product presented by the concessioner, examining and measuring the same. He will make out, in duplicate, the manifest for each shipment, and give one copy of this to the concessioner.

ART. 64. The concessioner shall not load, sell, nor use any forest product which has not been paid for, unless he has had express authority from the Chief of the Forestry Bureau and has given a satisfactory guaranty to that official.

ART. 65. 1. A manifest will not be necessary in case the forest product is not to be removed from the jurisdiction of the town in which the forest is situated.

In this case, after having examined, measured, and valued said product, the forestry official of the district or section gives to the concessioner or his representative an order of payment to the internal-revenue office, stating amount to be paid.

2. This having been done, the concessioner or his representatives shall deliver the letter acknowledging payment to the official who made out the order, who shall acknowledge receipt of same, making a note at the bottom of the page of the official statement, which he will deliver to the interested party. Having complied with these conditions the owner of the forest product can dispose of same as he sees fit.

3. For any violation of these requirements, he will be liable to a fine of twenty-five per cent of the value of said product.

Art. 66. 1. When the forest product is to be transported by land or by river from one town to another, within the same province, the carrier must be provided with a manifest, signed by the concessioner or his representative and authenticated by the forestry official residing in the town where the timber or other forest product was cut or gathered, and in case there should be no such official there, then by the president or alcalde. Upon the arrival of said product at its destination, it can not be disposed of until the forms as provided for in the foregoing conditions are complied with.

2. The concessioner shall not remove said product, in case it is to be carried by land or river from one province to another, without having first paid its value in the internal-revenue office of the province in which the forest is situated.

3. The concessioner may remove said product after having the manifest indorsed by the forestry official to the effect that it has been paid for, and said manifest must accompany the person in charge of above transportation.

4. Should said product be transported by sea and shipped from one point to another in the Archipelago, the payment may, at the option of the concessioner, be made in the office of internal-revenue at the place of origin or destination.

5. In the first case, where payment has been made at place of origin, the concessioner will be governed by section three, in that the cargo must be accompanied by the manifest, upon which has been noted the receipt of the letter of payment.

6. In the second instance, he must be provided with the manifest given by the forestry official or by the president or alcalde of the town of departure, the concessioner being held responsible for any difference which may be found at the inspection at port of arrival.

7. The person in charge of forest products transported by sea will, within five days of arrival at port of destination, present the manifest to the nearest forestry official.

8. Failure to carry out the above requirement will render the party so offending liable to a discretionary penalty, which shall not exceed one hundred dollars.

ART. 67. 1. The chief forestry official of the district or section shall, after inspection, give the order to unload, after manifest has been presented, showing that said product has been paid for. If this verification of the cargo shows that the figures agree with the manifest, it shall be delivered to the interested party, noting on same the said fact.

2. If an excess of cargo should be found and should not exceed ten per cent of cargo, payment of full amount of cargo only shall be paid by the concessioner. But if such excess should be found to be more than ten per cent, a penalty, as indicated in article seventy-two, shall be paid by the concessioner, in addition to full payment on cargo as found at inspection.

3. If the product has not been paid for, the order of payment shall be given to the concessioner, made out for the amount as shown on the provisional manifest, and upon payment of which, as shown by the presentation of the letter of payment, the order to unload is given, and subsequent proceedings shall conform with that laid down in the preceding paragraph.

4. If the concessioner should, at the termination of his voyage, dispose of said product, without having first obtained the order to discharge, he shall incur a penalty of twenty-five per cent of the value of same, in addition to other penalties to which he may be liable for other violations.

5. In order to move said product after it has been unloaded, the owners or persons in charge must be provided with a manifest indorsed by the official who inspected at the time of loading. In

no instance shall the order to unload be used in place of the manifest in order to move the said product.

ART. 68. If payment on said product should be delayed more than one month, counting from the date of the order of payment, a penalty of fifty per cent of its value will be incurred.

ART. 69. In cases of accidents or of damage to ships, or where the product is carried in mail vessels, which can not be delayed in port, said product may be unloaded at once, having previously given a satisfactory bond or cash deposit, fixed in each case by the chief forestry official of the district.

ART. 70. 1. When a cargo of a forest product is to be exported to China, Australia, or any other point outside of the archipelago, the concessioner before loading shall pay into the internal-revenue office a sum equal to two dollars for each ton of capacity registered by the vessel in which the shipment is to be made, as a guaranty of payment of the value of said product.

2. After the deposit is made, loading may begin under a designated forestry official, who will make out the official statement of the product loaded.

3. This having been finished, the ship may begin her voyage and the concessioner should repair to the nearest forestry official in order to obtain the order of payment, and having proven same by presenting the letter of payment, an order will be made out which will enable him to withdraw his deposit and be free from all responsibility to this bureau for said cargo.

4. In case the manifest is not shown the forest product shall be detained and a fine of from one to five per cent of the value of the products imposed.

ART. 71. 1. Presidents or alcaldes of the towns who officially authenticate manifests which contain inaccuracies prejudicial to the State shall incur a fine of not less than five dollars.

2. Where a forestry official is unable to act, the president or alcalde of the town who fails, when called upon by a concessioner to inspect and measure the wood or other forest product, either in person or by sending another official belonging to the municipality, shall incur a fine of not less than five dollars.

ART. 72. Violations of these regulations as to time and manner of utilizing the public forest products, where no damage has been caused, will be punished by a discretionary fine, which shall not exceed one hundred dollars; in case damage has been caused, the party so offending shall be held responsible and pay for same, and shall pay, in addition, a fine of from ten to twenty-five per cent of said damage, according to the nature of the case.

In cases of grave violations of these regulations, by any concessioner or his representatives or employees, the license may be withdrawn, after due notice to the party in interest.

ART. 73. 1. All cutting or harvesting of the products of the public forests without license shall be considered fraudulent, and will be punished as follows:

If the products be not timber, and subject to payment, the delinquent will be compelled to pay the value of the same and damages, and also a fine for the first offense of from twenty-five to fifty per cent of said value, fifty to seventy-five per cent for the second offense, and one hundred per cent for the third offense, with confiscation and loss of products.

2. If the product is timber, and whether subject to payment or not, the delinquent shall pay the value of the same and damage, and also a fine of one cent for each ten cubic decimeters for the first offense, two cents per ten cubic decimeters for the second offense, and for the third offense two and one-half cents per ten cubic decimeters, with confiscation and loss of said timber.

ART. 74. Unauthorized clearing of public lands, especially by fire, is absolutely prohibited; offenders shall be punished by a fine of twenty dollars per hectare for the ground so burnt over, and in case of insolvency shall serve a term in prison to correspond to the time required to liquidate said fine at the rate of two dollars and a half per day; said term of imprisonment shall not exceed sixty days. The land unlawfully occupied must be immediately abandoned, this for the first offense; for the second offense thirty dollars per hectare and the immediate abandonment of the property, and in case of insolvency imprisonment as above described for a term not to exceed ninety days. For the third offense, fifty dollars per hectare and immediate abandonment of the property. In case of insolvency, imprisonment as above described not to exceed one hundred and eighty days. This penalty shall not be increased for subsequent offenses, but if it should be proven that the burning was done through malice, the offender shall be punished according to the Penal Code.[1]

Art. 75. 1. Persons owning lands containing trees suitable for lumber, firewood, or other forest products shall immediately present certified copies of their title deeds at this office for registration.

2. Forest products taken from private lands, whose owners have not complied with these requirements, shall be considered unlawfully taken.

Art. 76. In order that forestry officials may exercise an intelligent supervision over the utilization of forest products, all said products of lands owned by towns or by private individuals and which leave the jurisdiction where said lands are situated, shall be accompanied by a statement, signed by the owner or administrator of the estate and by the president or alcalde of the town, in which statement shall be described the number, class and amount of forest product and the place where cut or gathered, and shall also show a receipt from the Forestry Bureau of registration of title to said land.

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[1] Act No. 274 of the Civil Commission, dated October 21, 1901:

AN ACT PROHIBITING THE UNAUTHORIZED DESTRUCTION OF TIMBER ON PUBLIC LANDS.

By authority of the President of the United States, be it enacted by the United States Philippine Commission, that:

Section 1. The making of so-called "caingins," or clearings, on public lands, by felling or burning trees, is hereby prohibited.

Sec. 2. Any person violating the foregoing provision of this act shall, upon conviction, be punished by a fine of not more than one hundred dollars, in money of the United States, or by imprisonment for not more than thirty days, or both, in the discretion of the court, for each offense, and shall pay charges on timber unlawfully cut or burned in accordance with the rates fixed in General Order Numbered ninety-two, Office of the United States Military Governor in the Philippine Islands, issued June twenty-seventh, nineteen hundred, or in lieu of such payment, shall suffer one day's imprisonment for each dollar of unpaid charges.

Failure to present this statement will render the owner of said forest product liable to the penalties incurred by parties fraudulently taking forest products from the forests of the State.

Art. 77. The officer in charge of the Forestry Bureau is charged with the duty of preparing the blank forms necessary for the enforcement of the foregoing regulations and distributing the same as the necessities of the service may require.

By command of Major-General MacArthur:

E. H. Crowder,
Lieut. Col. Thirty-ninth Inf., U. S. Vols.,
Secretary.

O

Philippine Resins, Gums, Seed Oils, and Essential Oils

By Augustus P. West, Ph. D.
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and
William H. Brown, Ph. D.
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Bulletin No. 20

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To Div. of Forestry University of California, Berkel

with the Compliments of the Director of Fores

Manila, P. I.

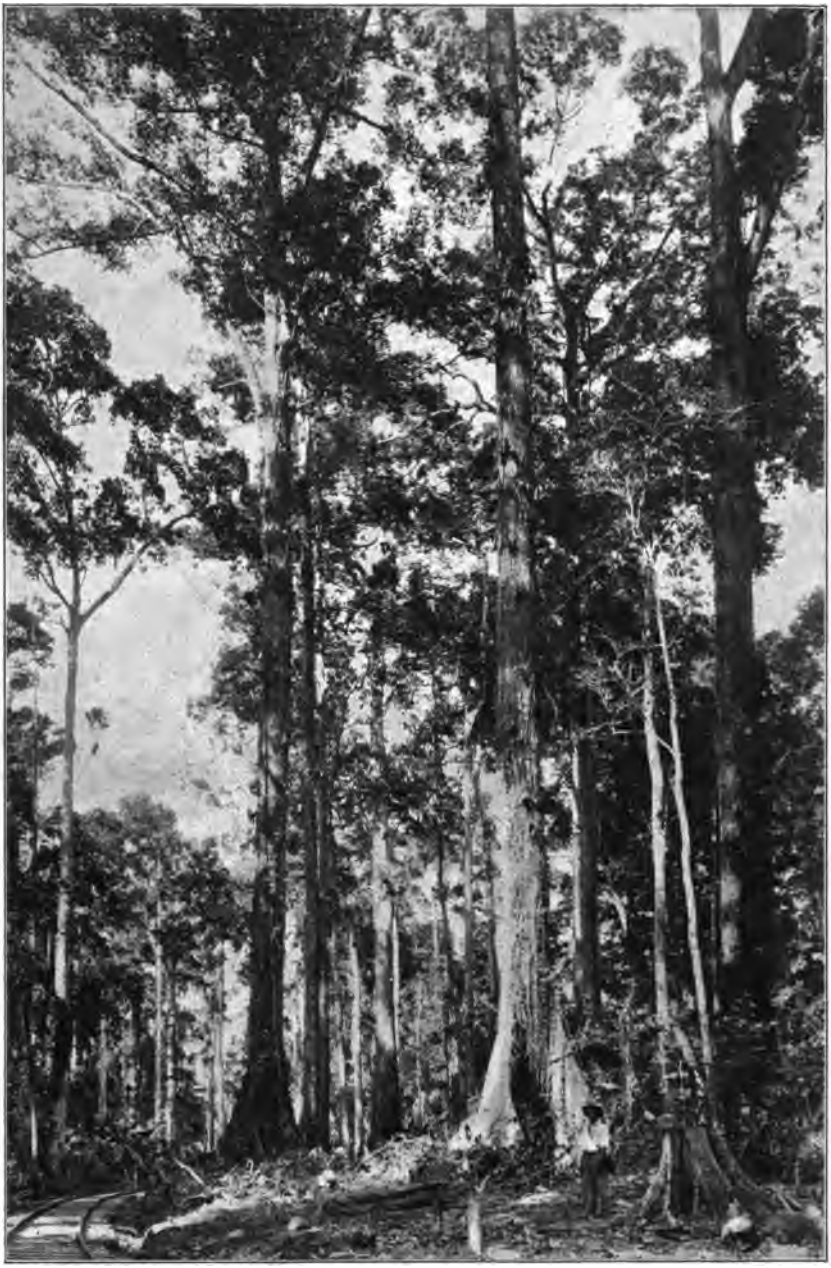

FIGURE 1. A GROUP OF LARGE DIPTEROCARPS IN THE FOREST OF NORTHERN NEGROS.

Philippine Resins, Gums, Seed Oils, and Essential Oils

By Augustus P. West, Ph. D.,
Professor of Chemistry, University of the Philippines
and
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Department of Agriculture and Natural Resources
Bureau of Forestry

Bulletin No. 20

Arthur F. Fischer, Director of Forestry

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PREFACE

For a number of years there has been in the Philippines considerable trade in the two resins, Manila copal or almaciga * and Manila elemi or brea blanca (Span., "white pitch"). The other resinous products of the Philippines have been used only to a very limited extent, while until recently there has been little commerce in Philippine oils other than ilang-ilang.

Copra, which is the dried meat of the coconut and the source of the coconut oil of commerce, was formerly shipped from the Philippines in large quantities. Of late, however, there has been an extensive development of the coconut-oil industry in the Archipelago, a number of oil mills having been established in Manila and other parts of the Islands. Consequently, coconut oil is now expressed from the copra in Philippine oil mills and exported to other countries. The local commercial activities in this industry have been greatly accelerated by conditions due to the recent world conflict.

This development of the coconut-oil industry has naturally led to a greatly increased interest in other oils and similar products; and so it seems fitting at this time to present a bulletin giving a short account of oils and resins which are the basis of commercial industries or which offer promising possibilities. From the discussions given in the introduction and in connection with the various species, it will be seen that a number of industries could be profitably developed, and that there are other new ones which are worthy of serious consideration.

In discussing the various species of plants, we have used the following system: On the left of the page is given the scientific name, and on the right the local name adopted as official by the Bureau of Forestry. A list of local names in the various dialects follows. The first part of the discussion takes up the general uses and importance of the products concerned. This is succeeded by a more technical description of the products, after

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* The Spanish name almaciga which is properly the equivalent of the English gum mastic (the product of *Pistachia lentiscus*) was incorrectly applied by the Spaniards in the Philippines to the resin of *Agathis alba*, a coniferous tree, and has become the commercial name, throughout the Islands, of the resin known in Europe and America as Manila copal.

which a description of the species is given, followed by a short account of its distribution and abundance. The local names are very convenient as assisting in the identification of the species, but are by no means infallible guides. It is believed, however, that by use of the local names, descriptions, and figures, it will be possible in most cases to identify the various species.

In preparing this bulletin, the writers have received valuable assistance from many sources, but particularly from Mr. E. D. Merrill, Director of the Bureau of Science, and Mr. E. E. Schneider, wood expert of the Bureau of Forestry. The native names have been revised by Mr. Schneider, who is conversant with several Philippine dialects, and who has taken great interest in the proper spelling of local names of Philippine plants. The original drawings were made under the direction of Mr. J. K. Santos by Messrs. F. de la Costa, P. C. Cagampan, J. Pascasio, S. Calusin, and Miss Maria Pastrana.

The writers are indebted to the Bureau of Science for the cuts used for figures 1, 18, 26, 27, 29, 31, 33, 36, 37, 60, and 62; to the Bureau of Education for figures 51 and 59; and to the Bureau of Agriculture for figure 53.

AUGUSTUS P. WEST.
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PHILIPPINE RESINS, GUMS, SEED OILS, AND ESSENTIAL OILS

By AUGUSTUS P. WEST AND WILLIAM H. BROWN

INTRODUCTION

The Philippine forests contain a large number of trees and other plants which produce seed oils, essential oils, resins, and gums. A number of such forest products are used locally, while a few enter into the foreign commerce of the Islands. The present bulletin aims to present a somewhat popular account of these various products.

A short account of agricultural, oil-yielding plants has been included for the sake of completeness. This has seemed the more advisable as there are only a few of them. The most important oil-producing plants, which can be regarded as strictly agricultural and never wild, are the coconut palm and peanut. There are in the Philippines a number of cultivated medicinal plants which contain oils. They are, however, for the most part unimportant, and oil is not extracted from them in the Archipelago.

Some of the resinous products and seed oils from Philippine forests are used extensively in the preparation of paints and varnishes, while others are employed for medicinal purposes, illumination, the manufacture of soaps, etc. A number of the resins, which occur most abundantly, are of comparatively little value at the present time, but some of these would seem to have promising possibilities.

A few of the Philippine essential oils (the odoriferous, volatile oils obtained from vegetable sources) are used commercially in the preparation of perfumes; and others would be valuable commercially, if this industry were properly developed. *Acacia farnesiana* (aroma) is a very common species in grasslands and open places in the Philippines. In France this shrub is grown extensively for the perfume obtained from its flowers, known as cassie flowers. There is no record of such a utilization in the Philippines.

The chief difficulty encountered in the collection of products from Philippine forest trees is that the forests usually contain a large number of species, so that a given species, although of wide distribution, may occur only in small numbers in a limited area. Many of the Philippine oil-producing plants grow well under cultivation, and the greatest development of oil industries from such plants will be dependent on their being grown in plantations by private individuals or in reforestation projects. A beginning has already been made in this direction, and in the case of *Canangium odoratum* (ilang-ilang) the oil is distilled largely from flowers grown under cultivation. *Aleurites moluccana*, the source of lumbang oil, is fairly common in some regions, and the oil, which is extracted commercially, is largely from wild trees. This species and also *Aleurites trisperma*, the source of bagilumbang oil, grow rapidly in plantations, and the trees fruit in a few years. These species are very promising for plantation and reforestation projects, and great numbers have already been planted. It can, therefore, be safely predicted that the future supply of lumbang and bagilumbang oils will be mostly from planted trees. As these oils are valuable, there are bright prospects for the development of a considerable industry in the handling of them. Several other oil-producing species which have been tried in limited quantities in plantations give promise of doing well. Among them may be mentioned *Pongamia pinnata*, *Sterculia foetida*, *Terminalia catappa*, and *Sindora supa*. *Canarium luzonicum*, the source of Manila elemi, also apparently does well in plantations. It would thus seem that the Manila elemi industry can best be developed from planted trees. This is probably likewise true of *Canarium villosum* and *Agathis alba*, although the latter species occurs in considerable abundance.

While most of the oil plants and some of the resinous ones grow for the most part as scattered individuals, this is not true of all the resin-producing trees. *Pinus insularis* grows in pure stands of considerable extent in the mountain regions of central Luzon, and *Pinus merkusii* in Mindoro. Most of the species of the family Dipterocarpaceae are large and dominant trees and grow in such numbers that immense quantities of resin could be produced. Unfortunately there is comparatively little market for these resins, although balau, from *Dipterocarpus vernicifluus*, *D. grandiflorus*, and other species of *Dipterocarpus*, and *Anisoptera thurifera*, appears to be very promising as a source of varnish resin and could be obtained in very large quantities. According to Foxworthy,* the species of *Dipterocarpus* make up

---

* Foxworthy, F. W., Philippine Dipterocarpaceae, II. Philippine Journal of Science, Section C, Volume 13 (1918), page 163.

20 per cent of the volume of the commercial forests of the Philippines.

Among cultivated species there are several which seem to offer promising prospects for the establishment of considerable industries. *Elaeis guineensis* (oil palm), which is used in the Philippines only for ornamental purposes, grows very well and is apparently not attacked by insects or fungi. In Africa this plant is grown very extensively for the oil derived from the seeds. Large plantations are also being started in Sumatra. Peanuts are raised in considerable quantities, but very little oil is extracted. In many countries, peanut oil is a commercial product of great importance. Sesame, which is grown in India and other countries on a huge scale for the production of sesame oil, grows well in the Philippines, but is cultivated only to a limited extent, and the oil is extracted merely for local purposes. Palm, peanut, and sesame oils are used extensively for edible purposes and for the manufacture of soap. *Achras sapota* (chico) is cultivated in the Philippines for its edible fruit. This species is grown extensively in Mexico for the production of gum chicle, the principal material employed in the manufacture of chewing-gum.

From the above discussion of oils, resins, and gums, it will be seen that there are promising prospects for the development of industries which already exist and for the establishment of a number of new ones.

RESINS

Resins and gums are products obtained from the exudations of plants. The products may exude spontaneously, but are more often secured by making incisions in the bark or trunk. It is somewhat difficult to draw a sharp distinction between gums and resins, as there are a number of plant exudations known as oleoresins, balsams and gum resins which have properties intermediate between those of true gums and resins. In general, plant products of this nature contain resins, gums, volatile oils, and aromatic acids. Allen * gives a very satisfactory discussion of resins and the methods used in analyzing them.

Resins are solid or semi-solid and are usually insoluble in water, but soluble in alcohol, ether, and volatile oils. They are formed usually by the spontaneous evaporation of resinous juices which exude naturally from the trunks of trees or when the trunks are cut. Frequently resins may be extracted from various parts of plants by solvents such as alcohol and ether. They are also found as minerals (mineral resin) which are, no doubt, products of extinct vegetation. Resins from different sources frequently show great differences in their chemical composition and properties. Commercially, Manila copal, which is used in making varnishes, is the most important Philippine resin.

Oleoresins are the plant exudations consisting of resins dissolved in volatile essential oils. Manila elemi, employed in varnish making, and turpentine are examples of this class of substances occurring in the Philippines.

Gum resins are plant exudations, like gamboge, which consist of a mixture of resin and gum. Gamboge of an inferior quality can be obtained in the Philippines from *Garcinia venulosa* and probably from other species of *Garcinia.*

Certain of the dipterocarp resins can be collected in large quantities and appear to offer commercial possibilities as materials for the manufacture of varnishes.

Family PINACEAE

Genus AGATHIS

AGATHIS ALBA (Lam.) Foxw. (Figs. 2–4). **ALMÁCIGA.**

Local names: *Adiáñgau* (Camarines); *alinsagó* (Benguet); *almáciga* (Mindoro, Lepanto, Bataan, Tayabas, Benguet, Zambales, Palawan, Cama-

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* Allen, Commercial organic analysis, Volume 4 (1911), page 1.

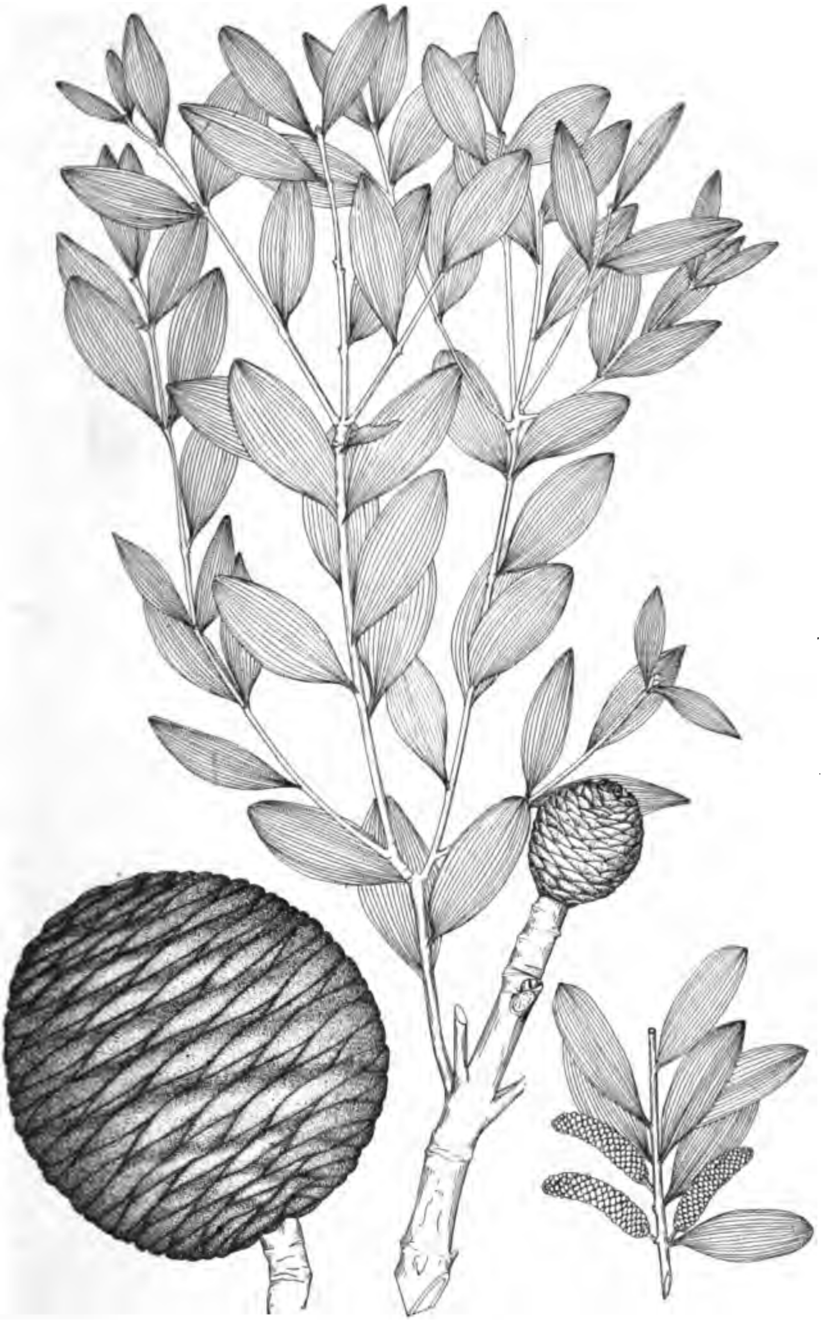

FIGURE 2. AGATHIS ALBA (ALMACIGA), THE SOURCE OF MANILA COPAL. ×½.

rines, Negros); *almaciga babae* (Bataan); *aniñgá* (Isabela); *aniñgát* (Calayan Island); *ánteng* (Nueva Ecija); *bagtík, baltík* (Palawan); *biáyo* (Bisaya); *bidiáñgan* (Negros Occidental); *bunsóg* (Benguet); *dadiáñgau* (Sorsogon, Polillo, Tayabas, Negros); *dadúñgoi* (Albay, Sorsogon); *galagála* (Bataan, Palawan); *ladiáñgau* (Camarines, Sorsogon, Tayabas); *makáu* (Misamis); *píno* (Samar); *sálong* (Cagayan, Negros); *títau* (Abra); *úli* (Zambales).

ALMACIGA OR MANILA COPAL

The chief value of *Agathis alba* is in the resin (almaciga or Manila copal) which it yields. Locally this is employed as incense in religious ceremonies, for torches, starting fires, caulking boats, as a smudge for mosquitoes, etc. It is exported in considerable quantities, and used chiefly in the manufacture of high-grade varnish, but also in other processes, as in making patent leather and sealing wax. Almaciga is suitable, according to Richmond,* for the manufacture of cheap soaps and paper size. Aqueous solutions of the alkaline resinates are precipitated by solutions of all other metallic salts, e. g., aluminum sulphate, in the form of an insoluble resinate, which could be used in paper manufacturing to render the paper non-bibulous. The exports of almaciga from the Philippines from 1914 to 1918 are given in Table 1.

TABLE 1.—*Amount and value of Manila copal exported from the Philippines from 1914 to 1918.*

Year.	Amount.	Value.
	Kilograms.	*Pesos.*
1914	1,112,787	225,078
1915	1,304,975	206,446
1916	1,143,938	211,593
1917	598,560	188,940
1918	507,116	138,821

Agathis alba belongs to the pine family and to the same genus as the "kauri pine" (*Agathis robusta*) of New Zealand. The latter yields a resin very similar to almaciga and one which has long been important in the industries.

Manila copal is a member of the class of substances known as copals. These substances are obtained as resinous exudations from various trees or as fossil (mineral) resin and are used principally for manufacturing varnishes. According to Hyde:†

---

* Richmond, G. F., Manila copal. Philippine Journal of Science, Section A, Volume 5 (1910), pages 177 to 201.

† Hyde, F. S., Solvents, oils, gums, waxes and allied substances (1913), page 35.

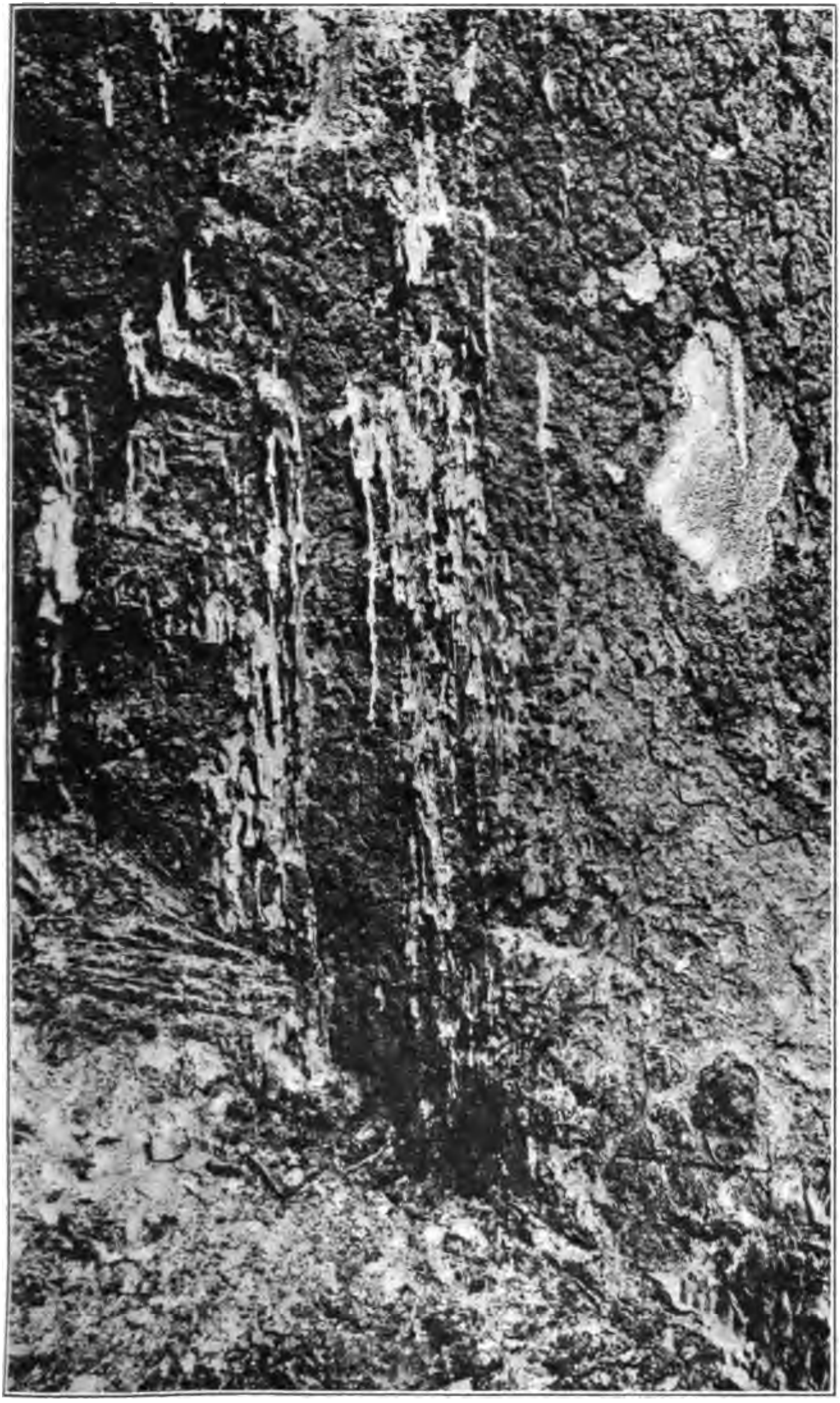

FIGURE 3. TRUNK OF AGATHIS ALBA (ALMÁCIGA), WITH SCARS FROM WHICH MANILA COPAL IS EXUDING.

True copals are hard, lustrous, yellow, brown, or nearly white, and more or less insoluble in the usual solvents, but are rendered soluble by melting before making into varnish.

The copals are resins which contain those very permanent substances known as resenes.

Bottler and Sabin * state that:

> * * * they contain, moreover, ethereal oils, which are driven off by melting or distillation, a bitter principle, and coloring-matter. Zanzibar and Cameroon copals consist mainly of resin acids and resenes; * * * Manila is composed mostly of resin acids; but it contains more resene (12 per cent) than does Zanzibar (6 per cent). * * * .

Bottler and Sabin † further say:

> For making spirit copal varnishes only such copals can be used as will readily dissolve to a clear solution, free from slimy or stringy qualities. Manila and Borneo copals are used, the soft Angola and the newer Sierra Leone.
>
> These varnishes may be made by such formulas as the following:

		Parts.
(*a*)	Manila copal	16
	Venice turpentine	4 to 5
	Alcohol (95 per cent)	30

The resin of *Agathis alba* is found in the bark, and oozes out whenever the latter is cut (surface resin). Occasionally lumps of resin are found in the forks of branches, and large masses, the so-called fossil (mineral) resins, are found in the ground. These deposits are located by sounding the ground with sharp-pointed sticks. Such resin is often discovered in places where large trees have formerly stood, but which have long since died and decayed, leaving large masses of resin in the ground.

According to Richmond,‡ more than 50 per cent of the Manila copal exported from the Philippines is collected in the Davao district of Mindanao, and probably 90 per cent of the resin produced in that region is obtained by blazing living trees. The best results are secured by removing, from different sides of trees, strips of bark about one meter in length and 20 to 30 centimeters wide, thus providing clean surfaces on which the resin is deposited as it oozes from the cut end of the bark. The resin is also obtained by means of a wedge-shaped incision in the tree trunk. This method however does not provide a clean

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* Bottler, M. and Sabin, A. H., German and American varnish making (1912), page 13.

† Bottler, M. and Sabin, A. H., German and American varnish making (1912), page 131.

‡ Richmond, G. F., Manila copal. Philippine Journal of Science, Section A, Volume 5 (1910), pages 177 to 201.

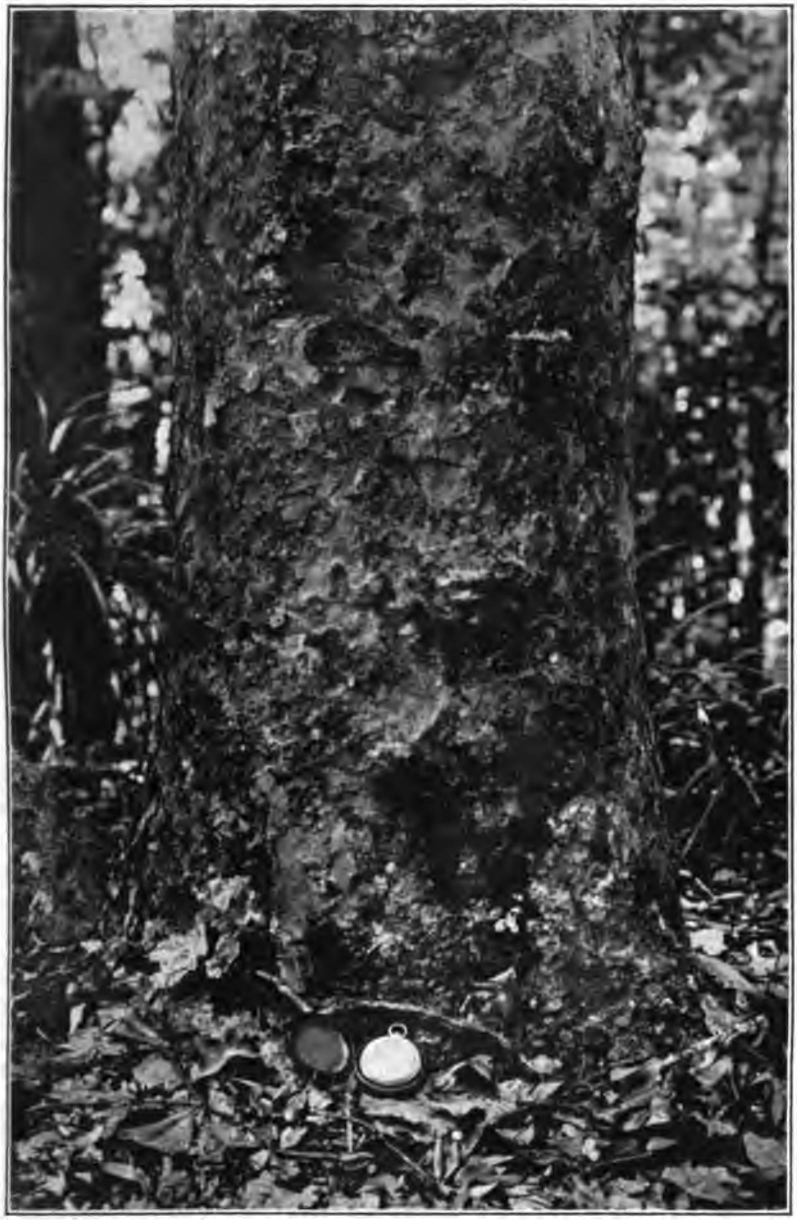

FIGURE 4. TRUNK OF AGATHIS ALBA (ALMÁCIGA), THE SOURCE OF MANILA COPAL.

surface, and the resulting resin is generally mixed with chips of bark.

When the resin first exudes from the tree, it appears as almost colorless tears, the outer surfaces of which soon harden. As exudation continues, the fresh resin instead of flowing out over the first portion produced appears to force the latter outward by being deposited beneath it. The outer surfaces are thus always hard and friable and the inner portion hardens very slowly. About two weeks are required to produce solid pieces of marketable size.

The Manila copal which is exported from the Philippines directly to the United States is cleaned, sorted, and graded in Manila. Particular attention is paid to cleanliness, color, and size. Manila copal is sometimes adulterated with other resins, particularly dipterocarp resins; the latter, however, are very readily distinguished from Manila copal. As the resin is collected largely by non-Christian tribes, the sorters in Manila frequently encounter considerable admixtures of other resins, and as the consumers have to depend largely on Philippine sorters, it is not surprising that the securing of a uniform quality of resin is a matter of some difficulty.

ANALYSIS OF MANILA COPAL

Almaciga has been the subject of a number of investigations by the Bureau of Science.*

Richmond examined recent surface and fossil (mineral) resin to ascertain the probable composition and character of these substances. The acid value was determined by dissolving approximately one gram of powdered resin in 50 cubic centimeters of absolute alcohol and titrating with a half-normal solution of alcoholic potassium hydroxide, using phenolphthalein as an indicator. A gram of surface resin required approximately 128 milligrams of potash for neutralization, while a gram of mineral resin required about 110.

The saponification value was determined in the following manner:—About one gram of resin was dissolved in 50 cubic centimeters of absolute alcohol. Twenty-five cubic centimeters of half-normal alcoholic potash were then added and the mixture heated on a steam bath (refluxed) for an hour. The excess of potassium hydroxide was titrated with a half-normal alcoholic solution of hydrogen chloride. A gram of surface resin required approximately 177 milligrams of potassium hydroxide for neutralization, while a gram of fossil resin took about 150 milligrams. The acid and saponification values of various samples of resin were determined. The results showed that darker specimens of resin gave higher acid and saponification values than did lighter-colored ones.

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* Foxworthy, F. W., The almaciga tree: *Agathis alba* (Lam.), Philippine Journal of Science, Section A, Volume 5 (1910), pages 173 to 175.

Richmond, G. F., Manila copal. Philippine Journal of Science, Section A, Volume 5 (1910), pages 177 to 201.

Brooks, B. T., The destructive distillation of Manila copal. Philippine Journal of Science, Section A, Volume 5 (1910), pages 203 to 217.

Brooks, B. T., The oxidation of Manila copal by the air. Philippine Journal of Science, Section A, Volume 5 (1910), pages 219 to 227.

Samples of surface resin were distilled with steam, but only traces of volatile oil were obtained. Fossil resin which was finely pulverized yielded a larger proportion of volatile oil. When steam-distilled in the presence of an alkali, 500 grams of surface resin gave 6.5 grams of oil, while an equal quantity of fossil resin gave 40 grams of oil. The oil obtained by steam distillation when dried over solid potassium hydroxide had a pale-lemon color and pleasant odor. This was fractionally distilled. The main fraction boiled between 155° and 165°. By treating with hydrochloric acid gas this fraction was converted into a hydrochloride which crystallized from alcohol and melted at 124°. This substance was identified as pinene hydrochloride.

A method of analysis devised by Richmond showed that one hundred parts of crude resin gave the following results:

	Parts.
Insoluble in absolute alcohol	.5
Soluble in alcoholic potash	40.0
Insoluble in alcoholic potash	41.5
Neutral oil soluble in alcohol and volatile with steam	6.0
Neutral resin partially soluble in alcohol and non-volatile with steam	10.0
Water, etc., undetermined	2.0

These results confirm the conclusion of Tschirch that Manila copal consists mainly of amorphous free resin acids, and contains a neutral resin indifferent to alkalies, and a volatile oil. Richmond extracted the resin acids from Manila copal by using a modification of Tschirch's method. An ether extract of Manila copal was treated with 5 per cent ammonium carbonate solution for several days, after which the mixture was acidified. The resin acids were precipitated as an amorphous powder. When this precipitate was dissolved in dilute alcohol and crystallized, white crystals melting at 186° were obtained. Analysis showed that these crystals had the molecular formula $C_{10}H_{15}O_2$ and that the resin acid was monobasic.

MANILA COPAL AS AN INGREDIENT OF VARNISHES.

As previously stated, Manila copal is used principally as an ingredient of varnishes. Spirit varnishes are solutions of resin in a volatile solvent such as turpentine, benzene, alcohol or some other solvent. Plain oil varnishes consist of only linseed oil or some other drying oil. The oleoresinous varnishes contain all the ingredients of both spirit and plain oil varnishes, and have properties common to both. The manufacture of oleoresinous varnishes consists essentially in mixing resin, turpentine, and a drying oil, such as linseed oil, in the proper proportions. Usually resins do not dissolve readily in drying oils unless the mixture is heated somewhat, and even then the resin frequently separates upon cooling. It is therefore customary to heat both the oil and resin before and after mixing. Richmond showed that although Manila copal loses weight when heated, the melted resin differs from the raw resin only in the amount and nature of unsaponifiable matter, that is, in the free amorphous acids. He concluded that the resin which enters into varnish manufacture consists essentially of free acids of the same composition as the free acids in the original copal, and that there is no particular reason for heating the resin to a high temperature either before or after mixing. He found that oleic, palmitic, and linolic acids dissolve the resin acids of Manila copal at moderate temperature.

> A quantity of the mixed fatty acids of linseed oil was prepared and added in varying proportions to raw linseed oil, depending upon the quantity of unmelted resin it was desired to dissolve, and it was found that raw or boiled linseed oil, containing the free, mixed, fatty acids of linseed oil in the proportions of 10 to 30 per cent calculated as oleïc acid, formed homogeneous solutions with raw or fused Manila copal when the latter is added in the proportion of 10 to 30 gallon varnishes and heated for a time at a maximum of 200°. When the turpentine was added before the oil, the boiling point of turpentine, 155° to 165°, was sufficiently high to effect complete solution with the exception of such foreign matter as may be present in the resin. The subsequent addition of turpentine to the oil and resin did not produce any cloudiness.

Varnish prepared as described above was used for varnishing native hardwood. The varnish film remained a year without showing any appreciable loss of luster.

Richmond concluded that:

> The changes which take place during the cooking of varnish are largely changes in the oil rather than the resin, i. e., it is possible so to treat linseed oil, either by boiling or by adding to it linseed-oil acids previous to its addition to the fused resin, that it will form a clear, homogeneous mixture with the latter which will remain so upon cooling, without subsequent heating to temperatures greater than 150° to 200°.

Richmond also prepared an oleoresinous varnish entirely from Philippine raw materials, consisting of lumbang oil, Manila copal, and turpentine. The lumbang was used in place of linseed as a drying oil. The turpentine was obtained by distilling the resin of the Benguet pine. Red narra wood, which had received two coats of this varnish, remained exposed for over a year without any appreciable loss of luster.

DISTILLATION OF MANILA COPAL

Brooks [*] carried out a number of experiments on the distillation of Manila copal. His results verified the observations of other experimenters that the distillation takes place in two stages. The first stage is characterized by considerable frothing. As the temperature rises slowly to about 330° the mass becomes fluid and boils gently. The loss in weight at this stage is about 14 per cent of the original sample. At about 340° the resin oil distils over in large quantities. The weight of oil obtained from 1,500 grams of resin was 94 grams. The fraction boiling between 150° and 178° gave 24 grams of oil, and contained limonene, pinene, terpineol, iso-borneol and β-pinene.

TABLE 2.—*Substances given off by Manila copal during the first stage of the decomposition, up to 330°.*

Substances.	Per cent.
Carbon dioxide	3.2
Water	2.4
Formic acid and acetic acid .... each	0.5
Formaldehyde, acetyl formaldehyde, furfuraldehyde, methyl alcohol, and acetone, approximately	0.2
Gaseous hydrocarbons	0.2
Pinene, limonene, dipentene, β-pinene, and camphene, variable	1.5–11.2
Resin oil, variable, usually from	3.0–6.0

Brooks also analyzed the gases given off during the first stage of the distillation of Manila copal and ascertained the quantity of carbon dioxide, unsaturated hydrocarbons, and saturated hydrocarbons. The principal products obtained by distilling Manila copal up to a temperature of 330° are given in Table 2. The solubility of Manila copal in various solvents was determined, with the results given in Table 3. These results are, however, only approximate, as different pieces vary somewhat in solubility.

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[*] Brooks, B. T., Destructive distillation of Manila copal. Philippine Journal of Science, Section A, volume 5 (1910), page 203.

TABLE 3.—*Per cent of substance dissolved from 10 grams of resin by 100 cubic centimeters of solvent.*

Solvent.	Per cent.	Temperature used to expel solvent.
		°*C*
Ethyl alcohol	95	130
Amyl alcohol	97	150-155
Ether	75	120
Ligroin	32	130
Benzene	50	135-140
Turpentine	46	170-175

OXIDATION OF MANILA COPAL

The absorption of oxygen from the air appears to be a property common to all complex resin acids. Brooks * investigated the oxidation of Manila copal by air and summarized his results as follows:

1. Manila copal rapidly absorbs oxygen from the air. The oxidation is accompanied by the formation of organic peroxides, an increase in the Koettstorfer number, and evolution of small quantities of carbon dioxide, formaldehyde, formic acid, and hydrogen peroxide.
2. The resin acids of Manila copal, when separated from the terpenes occurring in the natural resin, undergo oxidation by the air.
3. The evolution of carbon dioxide from Manila copal and colophony is probably due to the formation of organic peroxides and their subsequent decomposition.
4. The increase in the Koettstorfer number obtained by prolonged digestion with alcoholic potassium hydroxide is not due to oxidation during the course of the experiment, but is probably caused, at least in part, by the breaking down of lactones and organic peroxides. Samples which have been exposed to the air give up carbon dioxide and formic acid to the alkaline solution in the Koettstorfer determination and cause the recovered resin to show lower Koettstorfer numbers than the initial values.
5. Formaldehyde has heretofore not been noted among the products of the oxidation of organic substances by the air. I have found it among the products of the atmospheric oxidation of Manila copal.
6. The oxidation of Manila copal by the air is accelerated by sunlight.

Ingle † examined Manila copal to ascertain the effect of exposing it to the air. The material was finely ground and exposed to light and air. At intervals of 78 days, 13 months, and 2 years, the copal was weighed and the acid and iodine values determined. His results showed that the acid value was practically unchanged while the iodine value decreased. He also determined the solubility of Manila copal in various solvents, and suggested a method for estimating Manila copal in the presence of other resins. He believed that Manila copal, which is cheaper than kauri resin, could be used in place of the latter in certain dental-mould preparations.

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* Brooks, B. T., Oxidation of Manila copal by the air. Philippine Journal of Science, Section A, Volume 5 (1910), page 219.

† Ingle, H., Some notes on gum resins. Journal of the Society of Chemical Industry, Volume 31 (1912), page 272.

DESCRIPTION AND DISTRIBUTION OF AGATHIS ALBA

Agathis alba is a large tree reaching a height of 50 to 60 meters and a diameter, at breast height, of more than 2 meters; and with a clear length of trunk of 30 meters or more. The bark is 10 to 15 millimeters in thickness, brittle, and light greenish to brownish gray in color. It is shed in scroll-shaped patterns and is thickly set with corky pustules. The inner bark is brown, streaked with red and grading into a cream color near the sapwood. The leaves are simple, opposite or nearly so, leathery in texture, 3 to 9.5 centimeters long, and 1 to 2.5 centimeters wide.

The wood is moderately hard, flexible, and tough, though not resilient. The heartwood is pale yellow, sometimes with a faint pinkish or brownish tinge, generally turning to an even, very pale brown in drying.

This species was first described at length by Rumphius, who called it *Dammara alba,* which is the Latin form of the Malay common name, dammár putí. The same name was used by Lamarck in 1786, but the genus has since come to be known as *Agathis,* a name which is retained in the Vienna Code.

Agathis alba is found growing in considerable numbers in forests at altitudes of from 200 to 2,000 meters, but in the Philippines it usually attains its best development on well-drained slopes at from 600 to 1,500 meters elevation. The tree is very common in the Philippines and exists on mountain slopes throughout the Archipelago. It has been reported from the following regions: Cagayan, Isabela, Lepanto, Benguet, Abra, Zambales, Nueva Ecija, Bataan, Rizal, Tayabas, Polillo, Mindoro, Camarines, Albay, Sorsogon, Calayan Island, Sibuyan, Negros, Samar, Palawan, Misamis, Davao, and Zamboanga. *Agathis alba* also occurs in Cochin China, the Malay Peninsula, Sumatra, Java, Celebes, the Moluccas, and Borneo.

Genus PINUS

PINUS INSULARIS Endl. (Figs. 5–7). SÁLENG [*] or BENGUET PINE.

Local names: *Alál* (Zambales); *balibo, boobóo, bulbúl, ol-ól, sáung* (Benguet); *parua* (Iloko); *sáleng* (Bontoc, Lepanto, Abra, Nueva Ecija, Ilocos Norte and Sur).

TURPENTINE

Two species of pines are natives of the Philippines, one of which, *Pinus insularis,* was used in Spanish times as a commercial source of turpentine. Richmond [†] says that turpentine collected from this tree has an appearance and consistency somewhat like that of crystallized honey and possesses a pleasant odor; while Brooks [‡], after an investigation, states that it is practically identical with that produced in America.

Brooks measured the flow from a number of trees. Concerning the results he writes [§]:

> On March 13, fourteen trees situated in the forest adjoining the claim of the Headwaters Mining Company were boxed. The trees were selected at random and included several trees of the variety known to lumbermen and turpentine collectors as "scrub pine." Six hours later thirteen of the trees showed an abundant flow of resin, while one was hard and did not flow. The collected resin weighed 1,761.5 grams.
>
> On March 14, thirty trees were boxed in another locality about 2 miles distant from Baguio. They were selected with the idea of including both healthy and unhealthy looking trees and some which had been damaged by ground fires. On the following day these trees were again visited and all but three, which were hard and did not flow, were still running slowly. The collected resin weighed 4,400 grams.
>
> *Method of boxing.*—The boxes were cut about 30 to 40 centimeters wide, 12 to 18 centimeters deep, and 6 to 8 centimeters from front to back, varying with the size of the trees. They were made by inexperienced laborers and were so badly split and bruised that much of the fresh resin was lost, hence the yields obtained do not accurately represent the total flow of resin.
>
> One of the best flowing trees had a diameter of about 85 centimeters and produced 857 grams of resin in thirty-two hours, although a portion was lost by overflowing the box.

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[*] The words *sálong, sáleng, sáhing* and *sáing, sáong* or *sáung,* which occur so constantly as local names of trees of the Pine, Pili, and Lauan families (Pinaceae, Burseraceae, and Dipterocarpaceae), are all various dialectic forms of one word having the general meaning of "resin."

[†] Richmond, G. F., Philippine turpentine. Philippine Journal of Science, Section A, Volume 4 (1909), pages 231 to 232.

[‡] Brooks, B. T., The oleoresin of Pinus insularis Endl. Philippine Journal of Science, Section A, Volume 5 (1910), pages 229 to 231.

[§] Richmond, G. F., Philippine turpentine. Philippine Journal of Science, Section A, Volume 4 (1909), page 231.

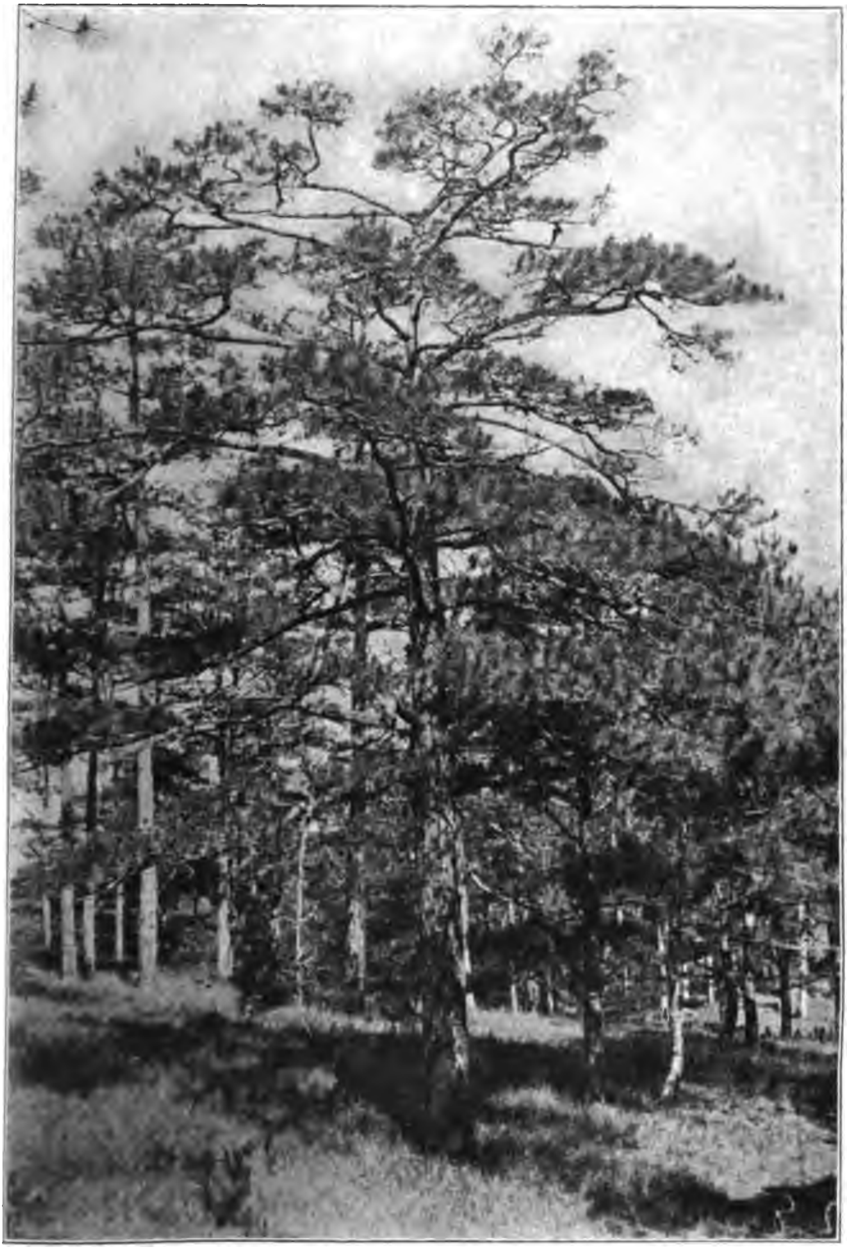

FIGURE 5. FOREST OF PINUS INSULARIS (BENGUET PINE) IN BENGUET MOUNTAINS.

These samples being taken during the dry season probably represent a smaller yield than would be obtained during the rainy season when the trees have more life and the loss by evaporation is less.

The cup and gutter system of collection would also give large yields by minimizing the loss.

Richmond * investigated the turpentine obtained from *Pinus insularis* and found that exhaustive distillation of the resin gave 412.2 grams (23.4 per cent) of oil of turpentine which was water-white in color, and after drying over calcium chloride gave the following results: Specific gravity, $\frac{30^\circ}{30^\circ}=0.8593$; refractive index, $N\frac{30^\circ}{D}=1.4656$; optical rotation, $A\frac{30^\circ}{D}=+26.5$. Ninety-six per cent distilled between 154° and 165.5°.

The residue from the steam distillation amounted to 76.6 per cent of the original resin and was freed from approximately 15 grams of foreign material by hot filtration. It consisted of pine colophony of a clear, pale-amber color.

Brooks † collected samples of the oleoresin from different trees and steam-distilled them, after which he determined the optical rotations. The values he obtained at 30° (+13.15° to +27.48°) were not very uniform, but the differences were not as large as those noted by Herty in the case of American turpentine.

The constants and chemical properties of the turpentine obtained from *Pinus insularis* indicate that the oil consists principally of pinene. Several derivatives of pinene, such as pinene nitrosyl chloride, were prepared from the turpentine. Brooks concluded that the turpentine and colophony from *Pinus insularis* are practically identical with those produced in America.

Pinus insularis reaches a height of 40 meters and a diameter of 140 centimeters. The bole is straight and clear, the crown narrow, with the lateral branches weakly developed. The bark is 10 to 25 millimeters in thickness, yellow or reddish brown in color, and broken in sections by vertical and horizontal cracks. The leaves are grouped in bunches of three, or sometimes two, and are 8 to 30 centimeters in length. The wood is moderately hard and heavy, resembling the yellow pine of the United States.

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[*] Richmond, G. F., Philippine turpentine. Philippine Journal of Science, Section A, Volume 4 (1909), page 231.

[†] Brooks, B. T., The oleoresin of Pinus insularis Endl. Philippine Journal of Science, Section A, Volume 5 (1910), page 229.

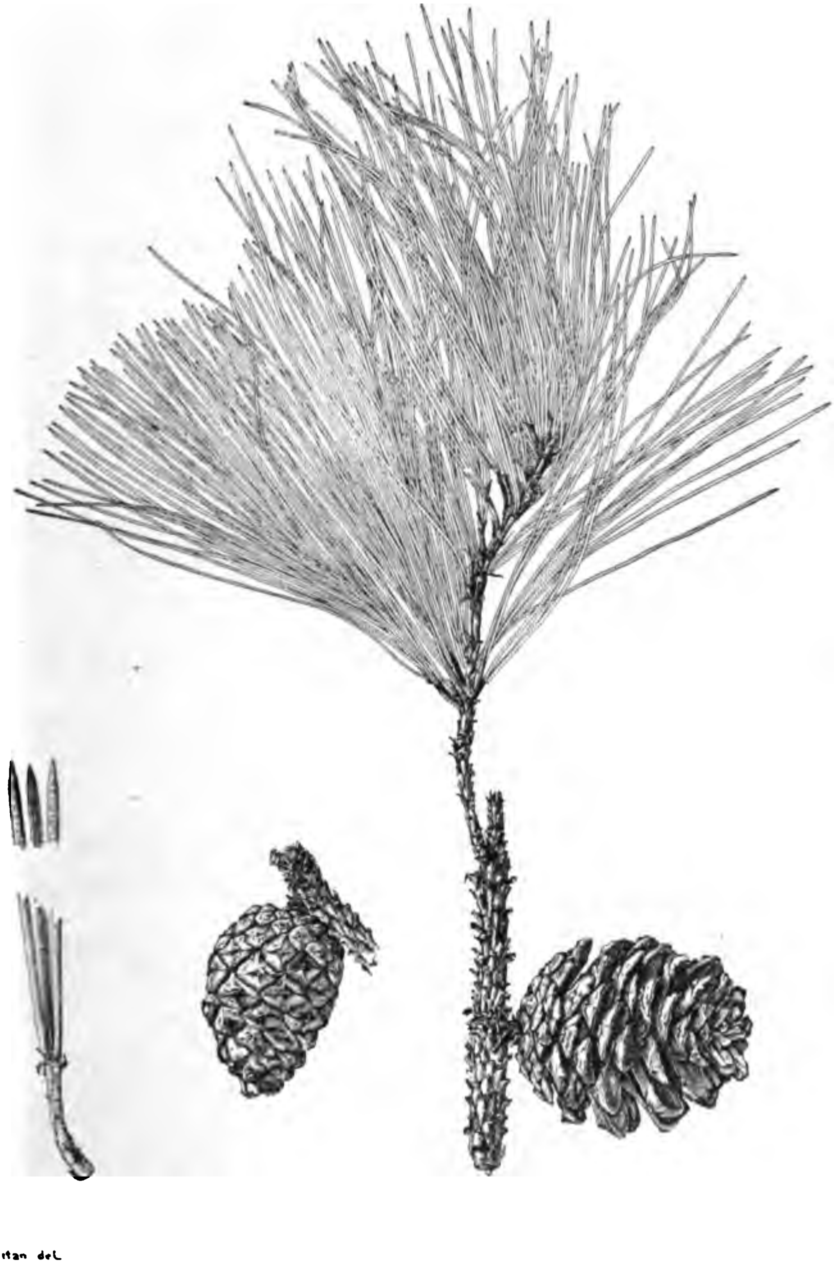

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FIGURE 6. PINUS INSULARIS (BENGUET PINE), A SOURCE OF TURPENTINE.

The sapwood is white; the heartwood white and reddish brown with alternate light and dark rings, and very resinous. It is used locally for house construction, mining props, etc.

This species is found in the highlands of central and northern Luzon at altitudes varying from 500 to 2,500 meters, but is best developed at altitudes ranging from 900 to 1,500 meters. The stands vary in density from those composed of scattered individuals to nearly closed patches. The ground in a pine area is usually covered with grass. In the ravines, broad-leaved trees occur and there is considerable evidence to show that nearly the whole area now occupied by the pines was formerly covered by broad-leaved trees, the pines being confined to steeper and dryer situations, where the other trees did not flourish. Through the activities of man in past centuries, the broad-leaved trees have been cleared off, and repeated fires have prevented their reproduction. The result of successive fires is usually to leave the lands in possession of grasses. The pines are less susceptible to fire than are the broad-leaved trees and consequently the former occur over wide areas. If fires were kept out, the pine, in the absence of competition with the broad-leaved trees, would quickly occupy the entire area, as its reproduction is abundant and rapid. The pines would then gradually be replaced by broad-leaved trees, as these will seed under the pines and cast such a dense shade as to prevent the growth of pine seedlings.

Measurements show a volume of 74 cubic meters per hectare (equivalent to about 7,400 board feet per acre) of pine trees which have a diameter of 25 or more centimeters.

PINUS MERKUSII Jungh. (Fig. 8). TAPÚLAU or MINDORO PINE.

Local names: *Agú-u* (Mindoro); *salit, tapúlau* (Zambales).

TURPENTINE

This species has not been investigated chemically, but its products are probably similar to those of *Pinus insularis.* The wood is apparently identical with the latter species, but seems on the average to be even more resinous.

Pinus merkusii is a tree reaching a diameter of about 90 centimeters. The chief difference between this species and *Pinus insularis* is that the needles occur in groups of two rather than three.

This species is found in Zambales and northwestern Mindoro, occurring in the latter region in pure stands. In Zambales, both *Pinus merkusii* and *Pinus insularis* are found at altitudes of only one or two hundred meters.

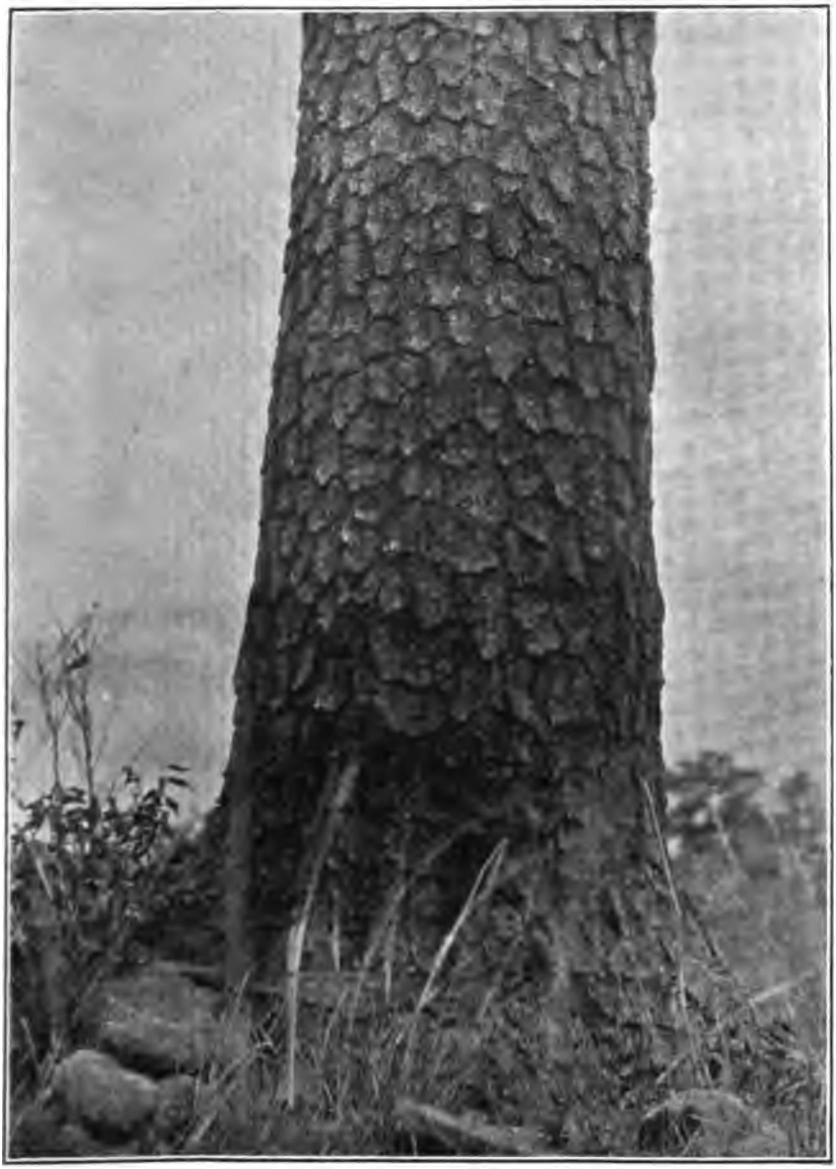

FIGURE 7. TRUNK OF PINUS INSULARIS (BENGUET PINE).

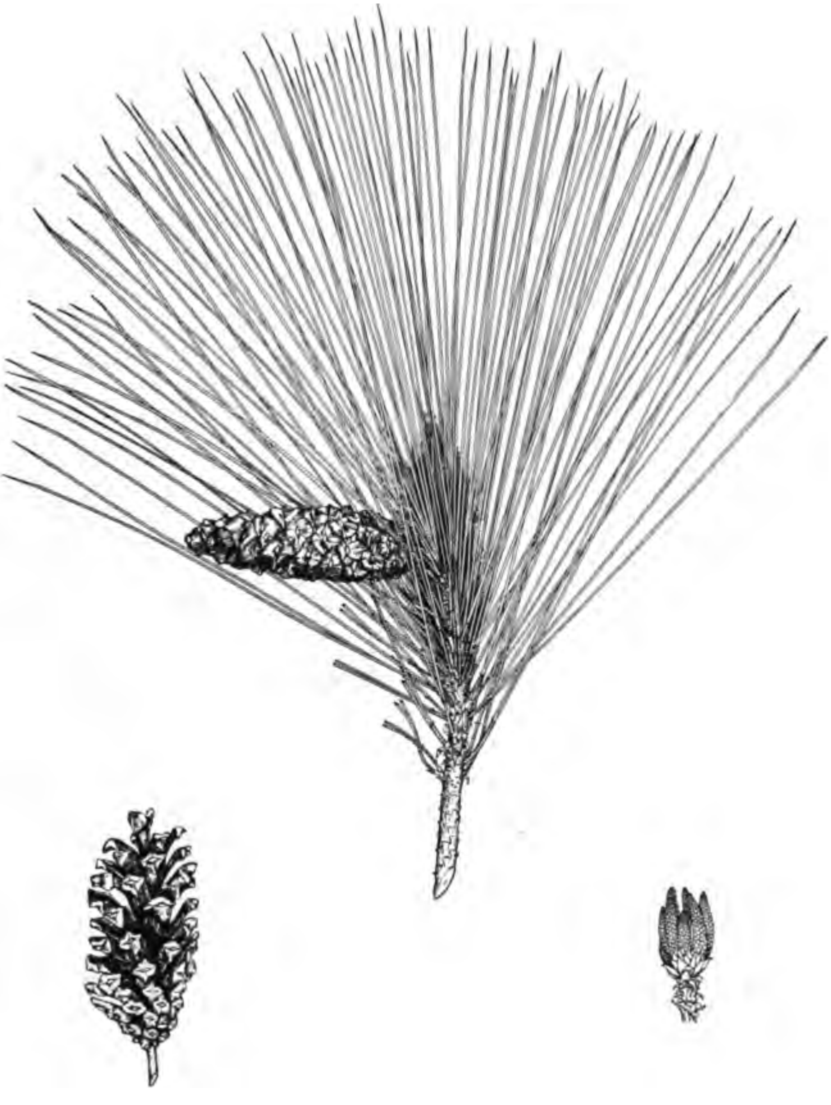

FIGURE 8. PINUS MERKUSII (MINDORO PINE), A SOURCE OF TURPENTINE. ×½.

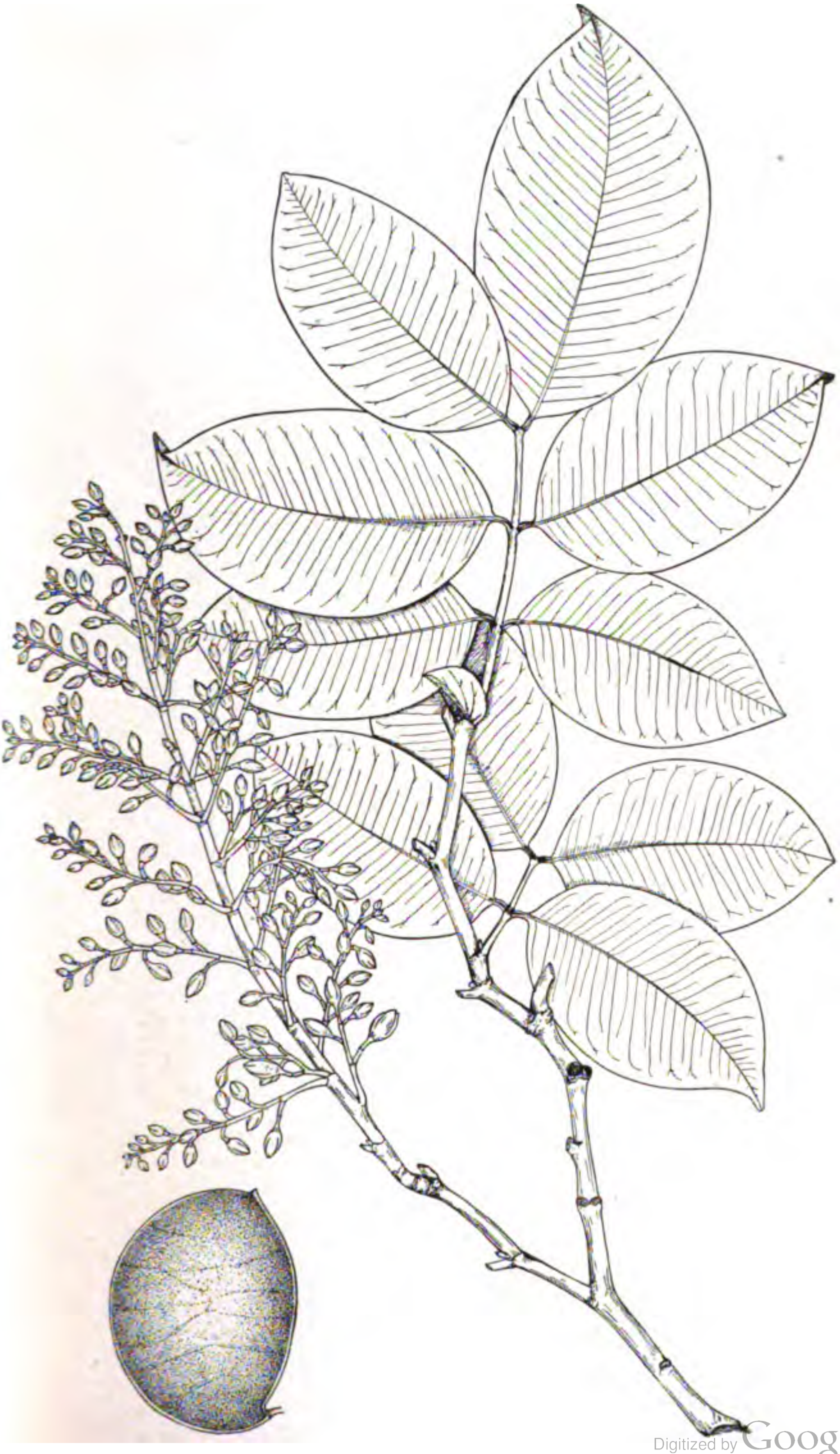

FIGURE 9. SINDORA INERMIS (KAYU-GALU), THE SOURCE OF KAYU-GALU OIL. X½.

FAMILY LEGUMINOSAE

Genus SINDORA

SINDORA INERMIS Merr. (Fig. 9). KAYU-GÁLU.

Local names: *Kayu-gálu* (Cotabato); *pariná* (Albay); *sinsúd* (Jolo, Manukmangka Island, Sibutu Island).

KAYU-GÁLU OIL

The trunk of this species yields a resinous oil known as kayu-gálu oil. It has a pleasant, persistent odor and should be useful as a perfume oil. Locally it serves much the same purposes as the oil of supa from *Sindora supa.* It has been exported in small quantities to Singapore by Chinese traders in Zamboanga.

Sindora inermis is a tree reaching a height of about 30 meters and a diameter of about 75 centimeters. The leaves are alternate and pinnate with four to eight leaflets, which are opposite, leathery, smooth, somewhat rounded at the base, usually pointed at the tip, and from 5 to 10 centimeters in length. The flowers are borne on compound, hairy inflorescences. The fruit is flattened, somewhat inequilateral, about 7 centimeters long, and 5 centimeters wide. *Sindora inermis* is distinguished from *Sindora supa* by the fact that the fruit of *Sindora inermis* is not armed with spines as is the case with that of *Sindora supa.*

This species is distributed from southern Luzon to Mindanao and Jolo.

SINDORA SUPA Merr. (Fig. 10). SUPÁ.

Local names: *Manápo, yakál-diláu, baláyong* (Tayabas); *supá* (Tayabas, Camarines, Albay, Zamboanga).

SUPÁ OIL

Oil of supa is obtained from this tree by making a cavity in the trunk. Clover * says that a freshly cut tree will yield about 10 liters of oil. The oil is non-drying, limpid, light yellow, homogeneous, with a slight fluorescence, possesses a pleasant aromatic odor, and does not become rancid. This oil is highly prized by the Filipinos for illuminating purposes and for the treatment of skin diseases. The oil of supa can be utilized in making varnishes, paints, transparent paper, and for the adulteration of other oils.

Clover * investigated the chemical properties of the oil of supa

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* Clover, A. M., Philippine wood oils. Philippine Journal of Science, Section A, Volume 1 (1906), page 191.

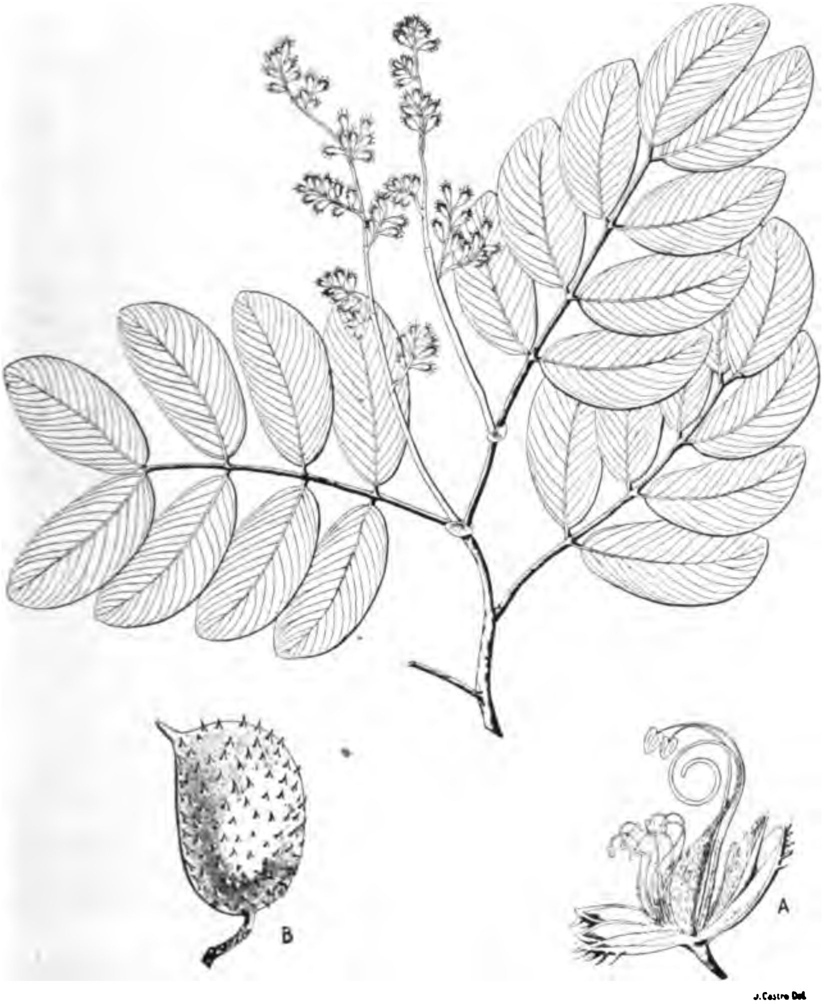

FIGURE 10. SINDORA SUPA (SUPA), THE SOURCE OF OIL OF SUPA.

and obtained the following results: Specific gravity $\frac{30^\circ}{30^\circ}=0.9202$. Optical rotation —31° .3 (10 centimeters, 30°). When cooled below 20°, white crystals of a hydrocarbon were obtained. This hydrocarbon is present to the extent of a few per cent. The oil is soluble in ordinary organic solvents except alcohol. When exposed to the air it absorbs oxygen slowly and finally hardens. When steam-distilled, a colorless oil is obtained. The absence of alcoholic substances was proved by the fact that the oil is not acted upon by sodium or phosphorous pentoxide in benzol. When an acetic acid solution of the steam distillate was treated with hydrochloric acid gas, cadinene hydrochloride was obtained. The oil is therefore probably a mixture of sesquiterpenes. The non-volatile portion of the oil which remains after distillation was recrystallized from alcohol. Its saponification number was found to be 64, which shows that the saponifiable matter is negligible.

Sindora supa is a tree reaching a height of 20 to 30 meters and, in exceptional cases, a diameter of 150 to 180 centimeters. The bole is straight, regular and without buttresses. The bark is 7 to 10 millimeters thick, brown to nearly black in color, and sheds in large scales. When the bark is freshly shed it exposes pink-colored patches. The leaves are alternate and simply compound, usually with three pairs of leaflets. These are smooth, leathery in texture, from 3.5 to 9 centimeters long, and from 2.5 to 5 centimeters wide. The fruit is a pod covered with straight, stiff spines on the ends of which drops of sticky oil accumulate.

The wood is hard and heavy. The heartwood is yellow or pinkish when fresh, gradually turning to a dark-bronze color with age. This wood was used formerly in general construction for beams, joists, rafters, etc., and in bridge, wharf, and ship building. It is now too highly prized for interior finish, furniture, and cabinet work, and especially flooring, to be put to the former uses. It is an excellent wood for fine turned and shaped tool handles, rulers and other desk supplies.

This species is intolerant of shade, occurs on limestone ridges, and appears to be confined to a limited portion of those regions without a distinct dry season.

Family BURSERACEAE

Genus CANARIUM

CANARIUM LUZONICUM (Bl.) A. Gray. (Figs. 11, 12). PILI.

Local names: *Alangkí* (Union); *ánteng* (Cagayan, Abra, Isabela); *bakóog* (Ilocos Sur); *buláu* (Pangasinan); *malapíli* (Camarines); *pagsaí-*

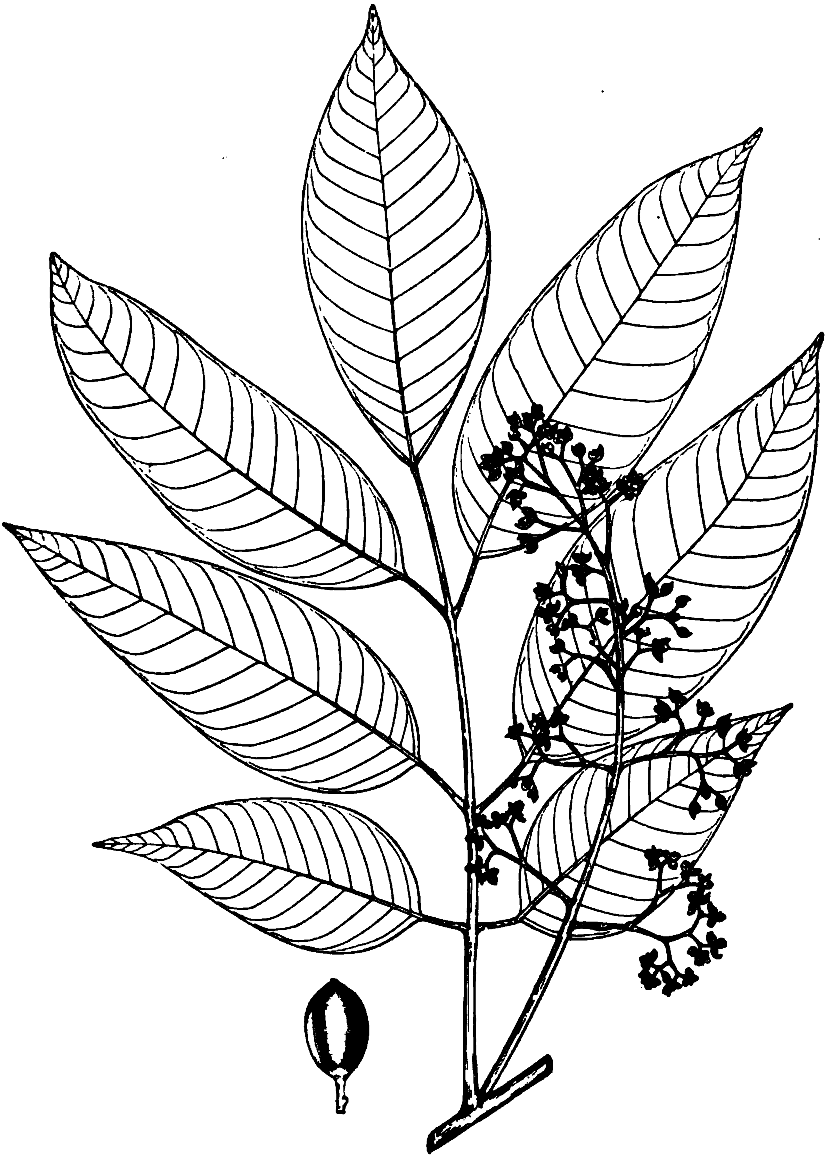

FIGURE 11. CANARIUM LUZONICUM (PILI), THE SOURCE OF MANILA ELEMI. ×½.

n̄gin or *pagsahín̄gin* (Rizal, Bataan); *palsahín̄gin* (Laguna, Bataan); *píli* (Tayabas, Masbate, Laguna, Mindoro, Rizal, Marinduque, Tarlac, Bataan, Albay, Sorsogon); *písa* (Cavite); *sáhing* (Bataan); *tugtugín* (Tayabas).

MANILA ELEMI

The name elemi is a term applied to a variety of resinous products obtained from different countries and having different botanical origins. There appears, however, to be little doubt that the species concerned all belong to the family Burseraceae. The greater part of the world's supply is derived from the Philippine Islands, and is known as Manila elemi. It is obtained from the trunk of *Canarium luzonicum* and is known locally by the Spanish term brea blanca (white pitch).

Brea of the best quality is soft, sticky, opaque, slightly yellow in color, has a very agreeable resinous odor, and burns with a smoky flame. It is used locally as a varnish, for caulking boats, and for torches. As the brea is very sticky, in preparing the torches, it is usually gathered in the most convenient way possible regardless of dirt and chips, and then kneaded on the ground by beating it with a piece of wood. When enough dirt has been mixed with it to make it stiff, it is rolled into shape and wrapped in a leaf of the anahau palm (*Livistona*). Near the forest, these torches are usually sold for 1 centavo each, but in towns they are retailed for about 3 centavos each. They give a very brilliant light and burn for a long time.

Manila elemi is exported from the Philippines in considerable quantities. The exports for the past five years are given in Table 4.

TABLE 4.—*Amount and value of Manila elemi exported from the Philippines from 1914 to 1918.*

Year.	Amount.	Value.
	Kilograms.	*Pesos.*
1914	85,652	9,478
1915	11,380	3,781
1916	104,311	45,852
1917	78,848	29,525
1918	17,136	9,828

Some of the resin is shipped from Manila to Europe for use in preparing medicinal ointments and, to a smaller extent, in the manufacture of varnish; while much of the product is sent to China and is there used for making transparent paper

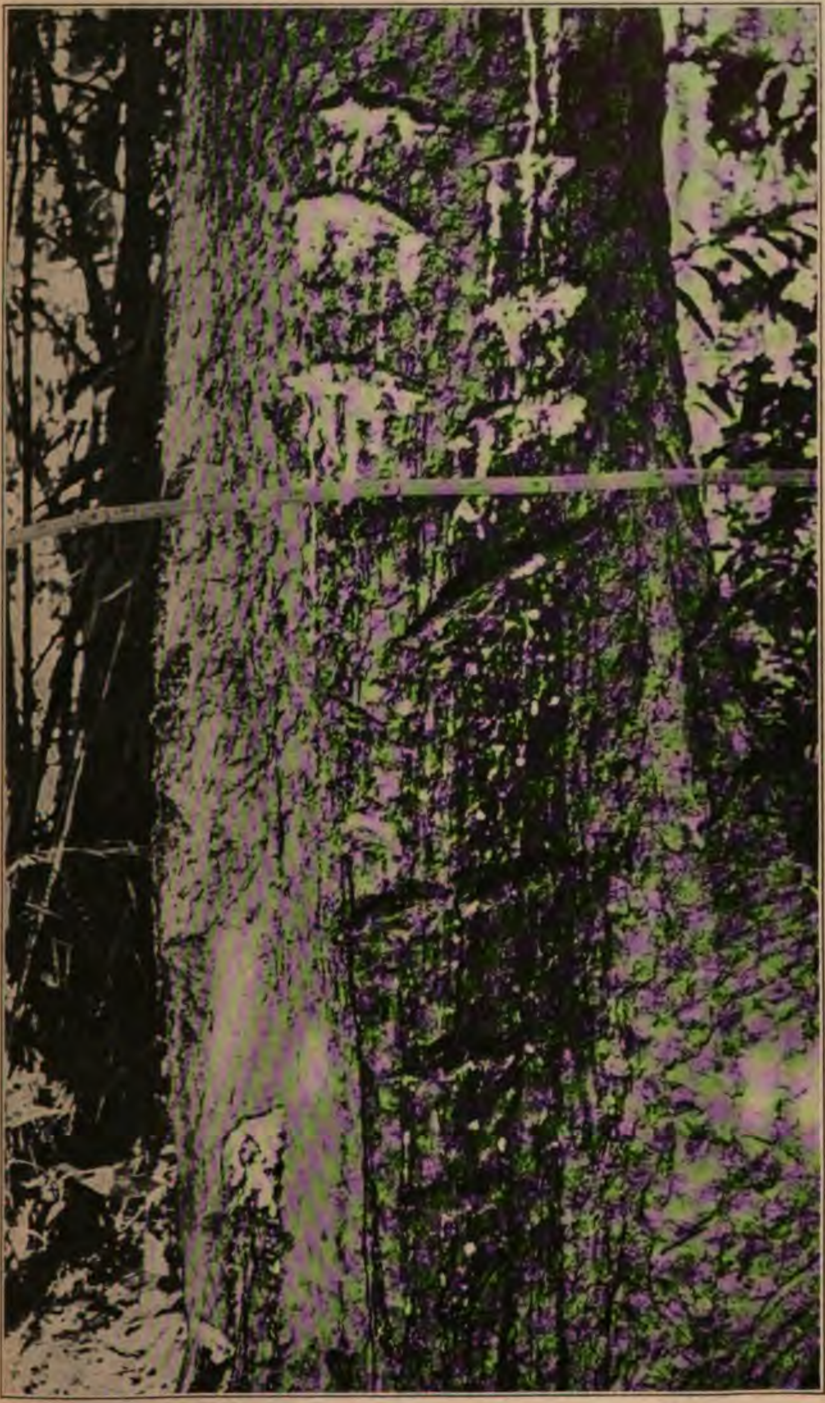

FIGURE 12. RESIN EXUDING FROM A TAPPED CANARIUM.

for window-panes, in place of glass. In America it is rarely employed medicinally.

The resin of Manila elemi is valuable as a material for preparing varnish, while the volatile oils are suitable for many purposes for which ordinary turpentine is used.

Bottler and Sabin *, in discussing elemi, say:

> * * * It is not by itself made into a varnish, but is added to a variety of spirit varnishes; it makes them less brittle and more elastic. For this the various sorts of elemi are better than turpentine, because they hold their volatile oil more tenaciously. To make varnishes elastic, elemi, castor-oil, and Venetian turpentine are melted together, and this compound is added to the solution of resin.

The following formula given by Bottler and Sabin is an example of an elastic varnish containing elemi.

WHITE VARNISH SUITABLE FOR BOOKBINDERS.

	Parts.
Sandarac	6
Mastic	3
Elemi	3
Alcohol	150

Concerning the use of Manila elemi for varnish, Bacon † states:

> The use of *elemi* residues with turpentine and linseed oil has not given us very satisfactory varnishes, for even with excessive quantities of driers, the varnish coat remains somewhat sticky for three or four days. This *elemi* residue, however, mixed with varying proportions of Manila copal, melted with boiled linseed oil, and properly thinned with turpentine has given us most excellent varnishes, which give a hard, brilliant, and elastic coating on wood. The use of the *elemi* resin for varnishes seems not only to give a paler and more brilliant varnish than copal alone, but renders the melting of the copal much easier. I believe this *elemi* resin distillation residue has a future as a varnish gum.

In the Philippines only one elemi gum is collected and this is obtained from *Canarium luzonicum*. When it first flows from the tree it is soft, but in the course of time hardens, the difference between the soft and the hard resin being that the latter has lost the greater part of its volatile constituents through evaporation.

In Masbate, according to Forester Zschokke, the trees are tapped at the beginning of the rainy season and the process is repeated every other day until December. The resin is collected once a month and one man can take care of from 75 to 100 trees.

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[*] Bottler, M. and Sabin, A. H., German and American varnish making, (1912), page 21.

[†] Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), page 100.

The trees must be visited regularly to get good returns. The resin can be gathered at almost all seasons, but towards the end of the dry season the flow is very slight. Resin is collected from the same trees year after year. Clover * says that he has seen large-sized trees on which at least ten pounds of resin had accumulated, probably within a month. Bacon † estimates that mature trees will yield an average of 45 kilos per year. He says that he has seen as much as 32 kilos of resin on a large tree. This amount represented a two months flow.

In some localities where the resin is collected, it sells for about 50 centavos per arroba of 11.5 kilos if clean and white, but when dark for about 30 centavos. In larger towns the best quality sells for about a peso a kilo and in Manila for about 3 pesos. If the industry of collecting the resin were systematized, the cost in Manila would certainly be greatly reduced.

Bacon ‡ collected over one hundred specimens of elemi resin from individual trees. These samples of fresh elemi resin were distilled *in vacuo*, the volatile oils were then separated from the water, shaken out with dilute alkalies, dried over calcium chloride, and redistilled *in vacuo;* only the terpene fraction was collected. The terpenes were then distilled at ordinary pressure. These results verified the conclusions of Clover that the terpene oils of elemi resin obtained from different trees showed great differences in their boiling points and especially in optical rotation. For purposes of purification and identification, the various distillates of elemi resin were divided into different groups according to their boiling points. Bacon found that these distillates consisted largely of various terpenes such as alpha and beta phellandrene, dipentene, limonene, etc. He prepared various derivatives of these terpenes, such as phellandrene nitrite, dipentene tetrabromide, limonene tetrabromide, etc. Judging from Bacon's experiments, the best method for purifying elemi resin is by solution in benzene, filtering off the impurities such as bark and dirt, and distilling the filtrate. A white resin of leafy appearance is thus obtained.

Bacon investigated nine samples of carefully purified terpenes from elemi resin obtained in Gumaca, Tayabas. The results are recorded in Table 5.

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* Clover, A. M., The terpene oils of Manila *elemi.* Philippine Journal of Science, Section A, Volume 2 (1907), pages 1 to 40.

† Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), pages 93 to 265.

‡ Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), page 93.

TABLE 5.—*Manila elemis from Gumaca, Tayabas.*

No.	$N \frac{30^\circ}{D.}$	Boiling point.	Specific gravity. $\frac{30^\circ}{4^\circ.}$	$A \frac{30^\circ}{D.}$
		Degrees.		
1	1.4674	175 -177	0.8360	116.8
2	1.4658	165 -169	0.8350	92.2
3	1.4673	175.5-178	0.8360	117.8
4	1.4672	175 -178	0.8359	111.8
5	1.4680	173 -175	0.8365	107.6
6	1.4670	175 -178	0.8358	117.9
7	1.4670	175 -178	0.8363	117.6
8	1.4660	166 -169	0.8355	90.7
9	1.4670	176 -177	0.8364	115.6

Bacon also investigated the residue left after the distillation of elemi. By the distillation of elemi *in vacuo*, he obtained from 12 to 18 per cent of terpenes and from 12 to 15 per cent of a higher-boiling oil. The distillation residue, usually amounting to about 70 per cent of the elemi, is a light-brown, transparent, solid resin, with a brilliant fracture. The elemi residue is completely and easily soluble in the cold in the following solvents: Alcohol, ether, benzol, petroleum ether, ligroin, xylol, chloroform, amyl acetate, acetone, methyl alcohol, carbon tetrachloride, ethyl acetate, turpentine, amyl alcohol, and glacial acetic acid. As previously stated, Bacon considered the residue obtained from the distillation of elemi to have important commercial possibilities as a varnish gum.

Clover * investigated the chemical properties of Manila elemi and found that:

> As ordinarily gathered for commerce, the resin is soft, sticky, and opaque, has a slightly yellow color, and a very agreeable odor. It has a spicy, somewhat bitter taste. If left exposed to the air for some time, it gradually hardens throughout and finally becomes brittle. The resin dissolves readily and completely in ether, chloroform, and benzene, except for the separation of a small amount of water which it contains and also a very small amount of a white, granular substance. In acetic ester, acetone, ligroin, methyl and ethyl alcohol it does not dissolve completely unless sufficient solvent is used. With these solvents a white, crystalline residue remains which, with the use of alcohol in limited quantity, amounts to about 25 per cent of the total * * * . Very soft Manila *elemi* contains a considerable amount of water, less than 5 per cent however, while that which has collected on the tree for a length of time contains very little.

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* Clover, A. M., The terpene oils of Manila elemi. Philippine Journal of Science, Section A, Volume 2 (1907), pages 1 to 40.

The volatile portion of elemi resin is called elemi oil and is usually obtained by steam-distilling the resin. Clover collected samples of elemi resin from different trees. These samples were distilled and the optical rotation, specific gravity, and refractive index of these various distillates determined. The results varied considerably. Clover concluded that the great variation found in the different oils was due to a difference in the resin obtained from different trees. The following experiments performed with a sample of Manila elemi show the general procedure followed throughout in working with this resin.

> *Sample II* was collected near Atimonan, Tayabas, from a tree having a diameter of about 3 feet near the base and laden with unripe nuts. The sample, of which 815 grams were used, was softer than the previous one.
>
> The first distillate at 125°, amounted to 50 grams (II, A); the second at 210° (II, B), was 123 grams; the third at 250° (II, C), was 30 grams. The terpene oil was distilled from II, B at reduced pressure and the residue added to II, C. The total terpene oil was 132 grams or 16.2 per cent; the high-boiling oil, 71 grams or 8.7 per cent.
>
> II, A was decanted from a small amount of water which collected with it. It was then distilled twice at 36.5 millimeters, passing over the second time almost completely between 82°.5 and 83°.5; three-fourths of it distilled at almost a constant temperature or at most within 0°.25 (II, A, purified). $\alpha^{30}_{D} = +100°$. The product gave no test for phellandrene. With bromine in acetic acid the 104° to 105° melting limonene tetrabromide was obtained and a granular nitrosyl-chloride was also readily formed. It also gave dipentene dihydrochloride melting at 50°. It was distilled from metallic sodium, after which it boiled completely between 176° and 177°, accordingly at a slightly lower temperature than I, A, purified; however, it possessed the same odor and, so far as could be determined, was identical in all other respects.
>
> II, C stood for over a year and was then fractionated twice at reduced pressure, whereupon about one-half of it was obtained as a light, yellowish-green product, boiling completely from 167° to 169°.5 at 35 millimeters (II, C, purified).
>
> $$\text{Sp. gr., } \frac{30}{4} = 0.9522. \quad \alpha^{30}_{D} = -2°.7. \quad n^{30}_{D} = 1.4973.$$

Clover was able to isolate various terpenes such as dextro-limonene, dextro-phellandrene, terpinene, and terpinolene from different samples of the resin.

Clover concluded that:

> The combined results obtained by a careful examination of the oils obtained from 21 individual samples of resin establish the true composition of *elemi* oil so far as these samples may be considered as representative of the aggregate product. In several cases, notably in the last sample examined, substances were obtained which were not encountered in any other; it seems possible, therefore, that were the investigation continued, still others would be found in which new constituents would appear,

although such cases would be rare and the substances themselves would constitute so small a proportion of the aggregate oil that they would scarcely need to be taken into account.

It is obvious that in considering Manila *elemi* or the oil obtained therefrom as products of a species, we must deal with an aggregate sample of these products; a sample derived from so great a number of individual trees that the peculiarities of the individuals disappear. If the native gatherer of resin utilizes a large number of trees and regularly removes the resin from them in small portions, the product which he places upon the market will be nearly homogeneous and a representative sample; but if he obtains his resin from a limited number of individuals his product will not be representative and, if he utilizes resin which has accumulated upon the trees in large quantity, it will not be homogeneous.

The great variation which I found at different times in the oil obtained from commercial *elemi* is readily explained. It is plain what the composition of *elemi* oil is when considered as an aggregate product; it should be remembered that to the laevo-limonene which accompanies phellandrene should be added an equal amount of dextro-limonene and the whole considered as dipentene.

Granted that we have a representative sample of resin, the composition of the oil will also be influenced by the following factors:

(1) The age of the resin.

(2) The temperature of the distillation. This factor will largely determine the proportion of the high-boiling part of the oil and will influence the composition of the terpene portion, because some of the terpenes suffer a change at higher temperatures.

(3) The length of time used in the distillation. This factor will influence only the proportion of high-boiling oil.

Yield of oil.—In the first seven samples examined considerable difference was found in the oil content. While there may be a certain amount of variation shown by the individual samples in this respect, it is thought that the differences found are more directly connected with the age of the resin. As previously noted, Schimmel & Co. state that the yield of oil is from 15 to 30 per cent. In several cases where I have examined samples of fresh, soft, resin purchased in Manila, I have always found the total yield to be from 25 to 30 per cent of the weight of the resin.

This species has been grown in plantations at Los Baños. Thirty-nine per cent of the seeds planted germinated. At the end of 7 years the trees averaged 4.37 meters in height and 4 centimeters in diameter.

Canarium luzonicum is a tree reaching a height of about 35 meters and a diameter of 1 meter or more. The leaves are pinnate, with usually three pairs of opposite leaflets and a terminal leaflet. The leaflets are smooth, pointed at the apex, rounded or obtusely pointed at the base, and from 12 to 20 centimeters in length. The flowers are fairly small and are borne on large compound inflorescences. The fruits are somewhat oval in shape, about 3 centimeters long, and contain a thick-shelled, triangular, edible nut.

This species is very abundant in the forests of Luzon and is also found in Marinduque, Ticao, Mindoro, and Masbate.

CANARIUM VILLOSUM F. Villa. (Fig. 13). PAGSAHÍN͠GIN.

Local names: *Antél* (Ilocos Norte); *ánteng* (Ilocos Sur, Ilocos Norte, Zambales, Abra, Cagayan, Pangasinan, Union); *brea* (Zamboanga); *dalít* (Pangasinan); *giret* (Cagayan); *koribó* (Isabela); *milipíli* or *saong-sáong* (Cebu); *paksahín͠gin* (Bataan); *pagsahín͠gin* (Laguna, Mindoro, Manila, Bataan); *palsahín͠gin* (Bataan, Rizal, Laguna, Batangas, Zambales, Marinduque); *patsaín͠gin* (Rizal); *písa* (Abra); *sáling* (Palawan, Bataan); *sulu-saún͠gan* (Negros); *tabúl* (Benguet).

PAGSAHÍN͠GIN RESIN

This species yields a resin known locally as sahing.

It is used locally for fuel and light and in some cases as caulking material for bancas.

Bacon * examined the oil obtained from this resin and found that it consisted principally of paracymol. In a later publication Bacon † gives the results of further investigation:

> In November, 1909, 3.5 kilos of resin were collected from one tree near Lamao, Bataan Province. The volatile oil was distilled from the resin *in vacuo* (4 to 6 millimeters) giving a total of 390 grams of oil (about 11 per cent). The latter had an odor like that obtained during a similar distillation of Manila elemi (*C. luzonicum* A. Gray), and the aqueous portion of the distillate contained a considerable amount of formic acid, although there were no visible evidences of decomposition of the resin during the distillation *in vacuo*. The oil was then distilled six times over sodium, using a column of glass beads in the neck of the distilling flask, and gave the following fractions:

Fraction No.	Weight.	Boiling point.	Refractive index, N $\frac{30}{D.}$	Specific gravity, $\frac{30}{30}$	Optical rotation, A $\frac{30}{D.}$
	Grams.	*Degrees.*			
1	102	154-158	1.4645	852	39.4
2	19	158-161	1.4660	851	34.7
3	45	161-165	1.4690	850	29.4
4	40	165-170	1.4730	849	21.1
5	47	170-175	1.4770	849	13.5
6	10	175-180	1.4795	----------	----------

> The residue was a thick, brown, viscous oil, which was attacked by sodium when an attempt was made to distill it over that metal.
>
> Fraction No. 1 had a strong odor of pinene, and Nos. 1, 2, and 3 each

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* Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), page 94.

† Bacon, R. F., Philippine terpenes and essential oils, IV. Philippine Journal of Science, Section A, Volume 5 (1910), page 257.

readily gave large yields of pinene hydrochloride, melting at 125°. From the higher boiling fractions a very small quantity of dipentene was obtained, the tetrabromide melting at 124°.

The principal constituent of the volatile oil of this sample of the pagsainguin resin is therefore *d*-pinene. In a previous paper I have shown, from the examination of a very large number of specimens of Manila elemi from individual trees, that the terpenes found in these trees vary quite markedly from tree to tree, and that one tree usually yields but a single terpene. The same would probably seem to hold good for the pagsainguin resin, and it appears probable that these *Canarium* trees manufacture a large series of terpenes and also the parent substance of terpenes, *p*-cymol. The next step will be to study the resin from one tree for a considerable length of time, to discover whether, for example, an individual tree always gives a resin containing pinene, or whether at one time it yields a product having pinene as a constituent, at another, a resin containing phellandrene, etc. * * * The resin should be of considerable value in making clear the physiologic process of the plant in the formation of resins.

Canarium villosum is a tree reaching a diameter of 1 meter or over. The young branches, leaves, and inflorescences are more or less covered with soft brown hairs; in age, they become nearly smooth. The leaves are pinnate and from 20 to 50 centimeters long; the leaflets 7 to 15 centimeters in length, the base rounded, or somewhat heart-shaped, the apex pointed. The flowers are greenish white, hairy, and 4 to 5 millimeters long. The fruit is about 1 centimeter long and rounded in cross section. The wood is very similar to that of *Canarium luzonicum.*

This species is a native of, and confined to, the Philippines. It is widely distributed.

Family DIPTEROCARPACEAE

All species of the family Dipterocarpaceae produce more or less resin. The dipterocarps are for the most part large trees, many of them reaching a height of 50 or 60 meters. They are the dominant species in the tall, lowland forests in the Philippines and in many other parts in the Indo-Malayan region. One of the most striking peculiarities of this family is that the species occur in large numbers, the bulk of many forests being composed of one or a few species of dipterocarps. As the dipterocarps constitute about three-fourths of the total stand of timber in the Islands, it is evident that the dipterocarp resins could be collected in great quantities. The most important of these resins are baláu, a resinous oil obtained from *Dipterocarpus grandiflorus* (apítong), *Dipterocarpus vernicifluus* (pánau) and other species of *Dipterocarpus,* and a similar resin from *Anisoptera thurifera* (palosápis). Baláu is used locally to a considerable extent and has commercial possibilities.

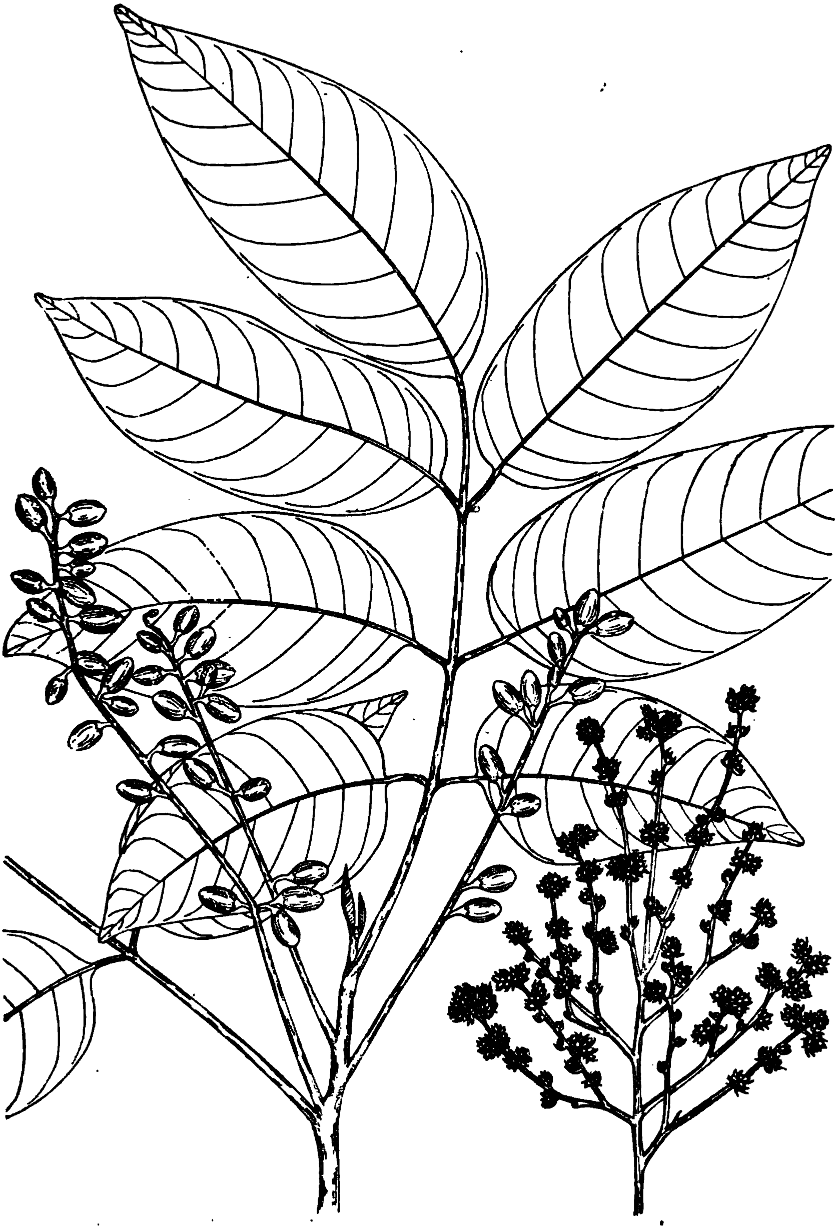

FIGURE 13. CANARIUM VILLOSUM (PAGSAHINGIN), THE SOURCE OF PAGSAHINGIN RESIN. ×½.

The Bureau of Forestry has authentic specimens of resin from *Hopea acuminata, Parashorea malaanonan, Pentacme contorta, Shorea balangeran, Shorea eximia, Shorea negrosensis, Shorea palosapis, Shorea polysperma* and *Vatica mangachapoi,* while Heyne reports that *Isoptera borneensis* yields resin in small quantities.

Balau hardens only after long exposure, but most of the dipterocarp resins harden rapidly to a dry, brittle consistency They vary from a light yellow or grayish tinge to almost black. Very little is known of the chemical composition or possible industrial uses of the various quick-drying dipterocarp resins.

Genus ANISOPTERA

ANISOPTERA THURIFERA Blanco. (Figs. 14, 15). PALOSÁPIS.

Local names: *Apítong* (Sibuyan Island, Capiz); *apnít, dúung* (Abra); *bagobalóng* (Samar); *bétes* or *létis* (Masbate); *dágang* (Rizal, Bulacan, Albay, Camarines); *dágum* (Laguna, Tayabas, Albay); *dúyong* (Ilocos Sur, Ilocos Norte); *lauán* (Rizal); *lauán putí* (Nueva Ecija); *létis* (Ticao Island, Iloilo); *mala-átis* (Rizal); *mayápis* (Rizal, Bataan, Zambales, Nueva Ecija, Bulacan); *palosápis* (Zambales, Pangasinan, Bataan, Nueva Ecija).

PALOSÁPIS RESIN

A resinous oil, frequently known as oil of palosapis, is obtained from the trunk of this species. This resin is very similar to balau from *Dipterocarpus grandiflorus,* is obtained in the same manner, and is used for the same purposes.

Clover * says that an examination of the resinous oil from *Anisoptera thurifera* (which he called mayapis) proved it to be similar to that from *Dipterocarpus grandiflorus* and *D. vernicifluus,* but that it dried much more rapidly than either of the latter; that it was light colored, apparently homogenous in composition, and so viscous that it could scarcely be poured. Heating to 100° caused it to harden, and exposure to the air produced the same effect, changing it to a pearly, white solid. He found that it contained 15 per cent of water and 25 per cent of sesquiterpene oil, which could be removed by careful distillation without decomposition. The residue was hard.

The oil redistilled at 17 millimeters, possessed the characteristic odor of the resin, and was very light yellow in color. Boiling point, 132° to 140° (17 millimeters. Specific gravity, $\left(\frac{30^\circ}{30^\circ}\right)=0.9056$.

Anisoptera thurifera reaches a height of 40 to 45 meters and

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* Clover, A. M. Philippine wood oils. Philippine Journal of Science, Volume 1 (1906), page 191.

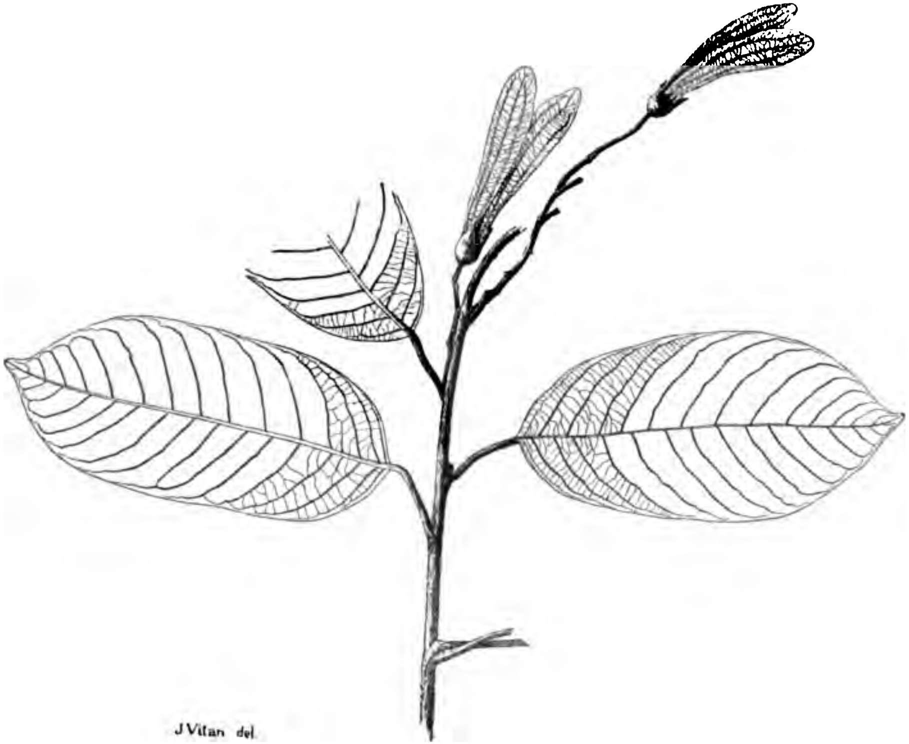

FIGURE 14. ANISOPTERA THURIFERA (PALOSAPIS), THE SOURCE OF PALOSAPIS RESIN.

a diameter of 140 to 180 centimeters. It has a straight, regular, unbuttressed bole that is three-fifths to two-thirds of the height of the tree. The canopy is dense during the rainy season and open in the dry, at which time it changes leaves. The bark is from 15 to 25 millimeters thick; in young trees smooth and with a yellowish tinge; in older trees, especially at the base, broken into irregular patches and dirty brown in color. The bark beneath the surface has a reddish-brown color; the inner bark is granular brownish-yellow; the granular coloring being due to broken, concentric rings of yellow. The leaves are alternate, rounded at the base, pointed at the tip, from 7.5 to 16 centimeters long, and from 3 to 7 centimeters wide. The fruit is rounded, 4 to 15 millimeters in diameter, and with two wings which are 5 to 9 centimeters long, and sometimes more than a centimeter broad.

The heartwood is yellowish with rose-colored streaks and blotches or evenly rose-colored. When seasoned, the color is pale yellow with reddish or light yellowish-brown markings. It is used considerably for construction.

This species is common and widely distributed in the Philippines. It has been reported from the following localities:—Ilocos Norte, Ilocos Sur, Abra, Pangasinan, Zambales, Nueva Ecija, Bulacan, Bataan, Rizal, Laguna, Tayabas, Camarines, Albay, Sibuyan Island, Capiz, Iloilo, Ticao Island, Samar, Masbate, Zamboanga. *Anisoptera thurifera* is the commonest and best known species of the genus in the Philippines, but the wood of all is known commercially as palosapis. According to Foxworthy,[*] palosapis ranks about tenth in order of abundance among the Philippine woods and makes up about 1.5 per cent of the volume of the forests.

Genus DIPTEROCARPUS

DIPTEROCARPUS GRANDIFLORUS Blanco. (Figs. 16–19). APÍTONG.

Local names: *Anaháuon* (Camarines); *apítong* (Bataan, Cagayan, Isabela, Abra, Benguet, Zambales, Nueva Ecija, Bulacan, Laguna, Tayabas, Camarines, Albay, Mindoro, Sibuyan Island, Samar, Negros, Palawan); *baláu* (Misamis, Sibuyan Island, Negros, Capiz, Misamis, Agusan); *danlóg, létis* (Capiz); *dúen* (Isabela); *dukó* (Isabela; Apayaó); *dukó, pamalalien* (Cagayan); *hagakhák* (Sibuyan Island); *himpagtán* (Samar); *kamúyau* (Palaui Island, Cagayan); *malapáho, mayápis* (Tayabas); *pagsahíñgan* (Laguna); *pamantúlen* (Pangasinan); *pamarnísen* (Cagayan, Camarines); *pánau* (Bataan, Zambales, Rizal); *pánau verdadero* (Bulacan).

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[*] Foxworthy, F. W., Philippine Dipterocarpaceae, II. Philippine Journal of Science, Volume 13 (1918), pages 163–197.

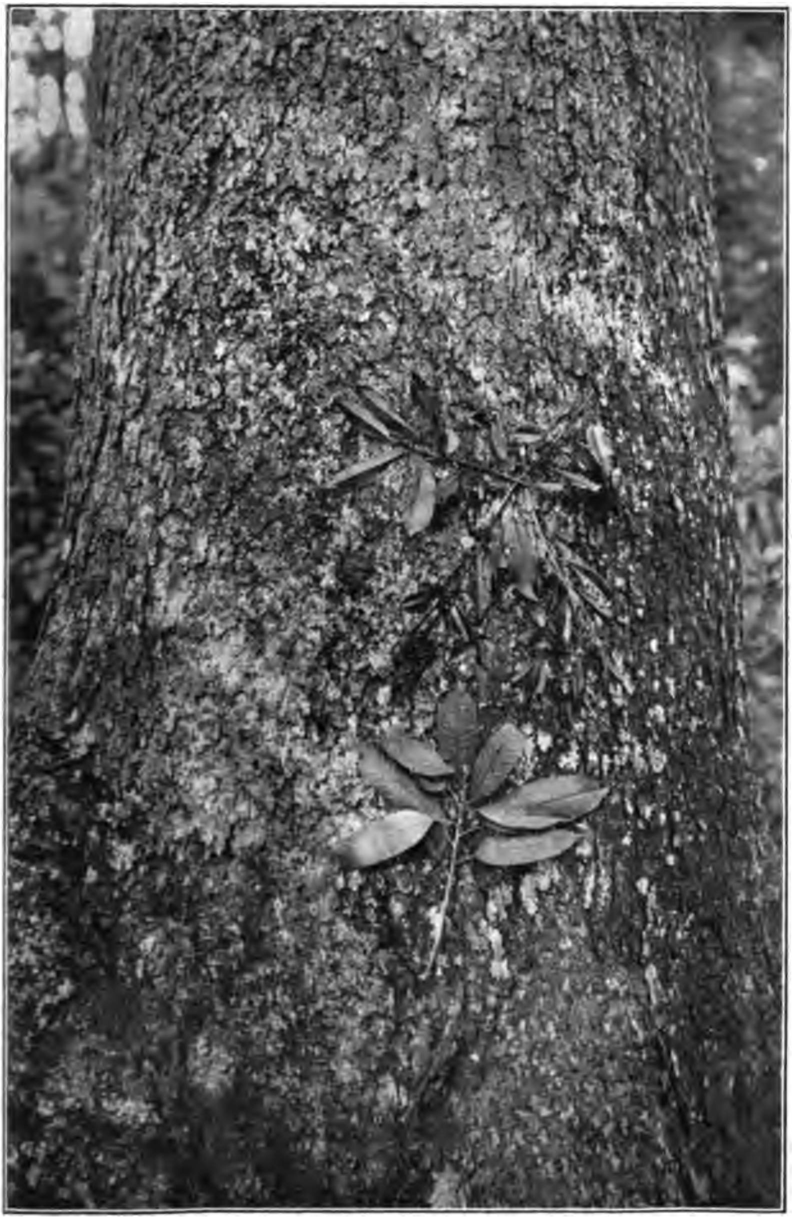

FIGURE 15. BARK AND LEAVES OF ANISOPTERA THURIFERA (PALOSAPIS), THE SOURCE OF PALOSAPIS RESIN.

BALÁU (APITONG) RESIN

Oil obtained from the trunk of this tree is known as baláu, and is used locally as an illuminant, for varnishing, and for caulking boats. Baláu resin used as a varnish produces a very brilliant, tough, and durable coating and according to Bacon * seems to have properties that would make its general use for varnish manufacture desirable. It has, however, the serious disadvantage of drying very slowly and, in its original state, has not yet been successfully combined with linseed oil or other dryers. Bacon, by distillation, obtained a hard, yellow, lustrous resin soluble to the extent of about 75 per cent in alcohol or turpentine, the solutions giving hard, lustrous varnish coatings. This resin dissolves completely in two volumes of linseed oil and two of turpentine, giving a varnish which dries slowly (five days) to a tough, hard coating.

Balau is collected by chopping into the tree and making a cavity where the oil can collect. Often the cuts extend halfway through the trunk. The flow may amount to more than a kilo per day. It is customary to remove the resin every few days and to apply fire to the cuts at frequent intervals. It is reported that the same tree can be tapped for a number of years. Tapping usually results in the entrance of decay organisms and the ultimate death of the tree. For this reason all trees which are tapped for balau should be cut and used for timber before the wood is destroyed.

Balau is a thick fluid when fresh, but hardens after long exposure to a semi-plastic condition. The total recorded production in 1917 was 54,080 kilos.

According to Clover † baláu consists of a solid resin, water, and a volatile oil which is present to the extent of about 35 per cent. Baláu has a feeble, characteristic odor and dissolves in the usual organic solvents except alcohol. The water which the oil contains appears to be chemically combined and is not removed easily by distillation. When distilled directly, all the water and a portion of the oil passes over below 260°. A sample was distilled under diminished pressure (40 mm.) at 151° to 154°. The optical rotation of this fraction was 78°.5 (10 centimeters, 30°). The specific gravity was $\frac{30^\circ}{30^\circ}$ =0.9127. It had

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* Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), page 93.

† Clover, A. M., Philippine wood oils. Philippine Journal of Science, Section A, Volume 1 (1906), page 195.

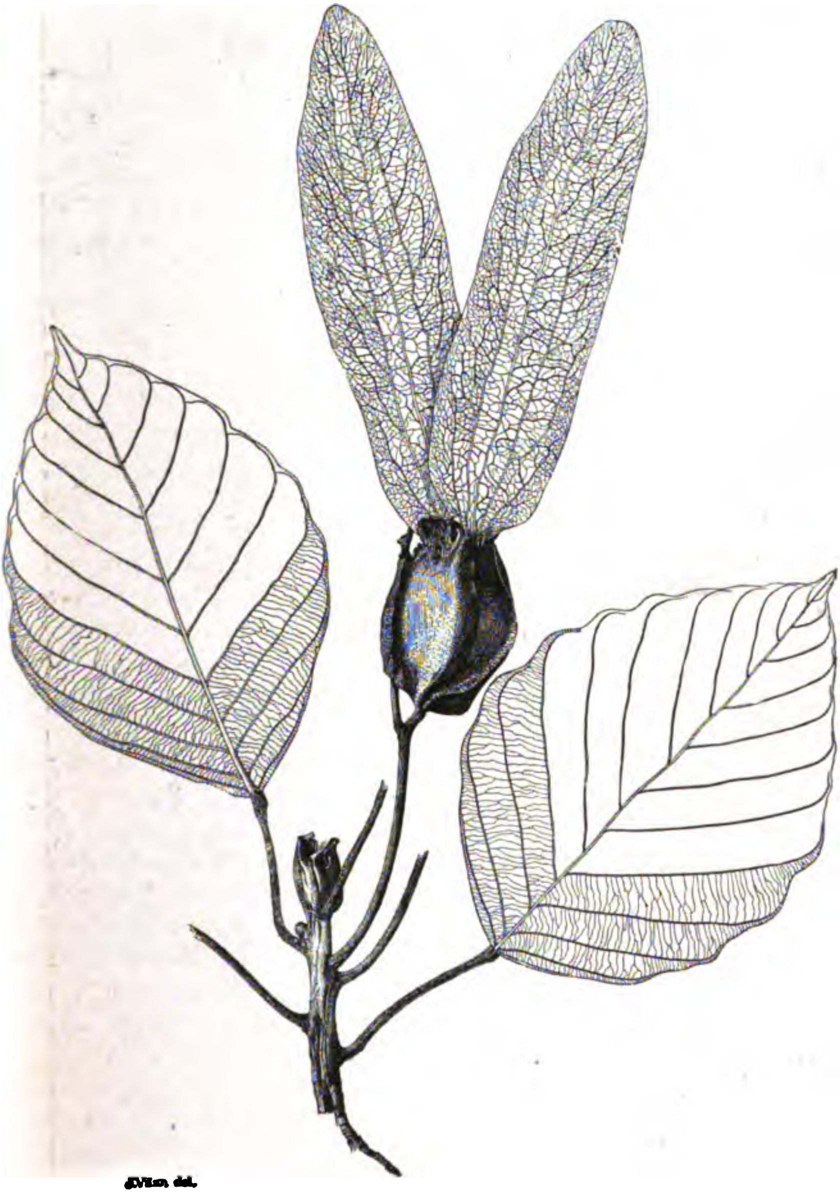

FIGURE 16. DIPTEROCARPUS GRANDIFLORUS (APITONG), A SOURCE OF BALAU.

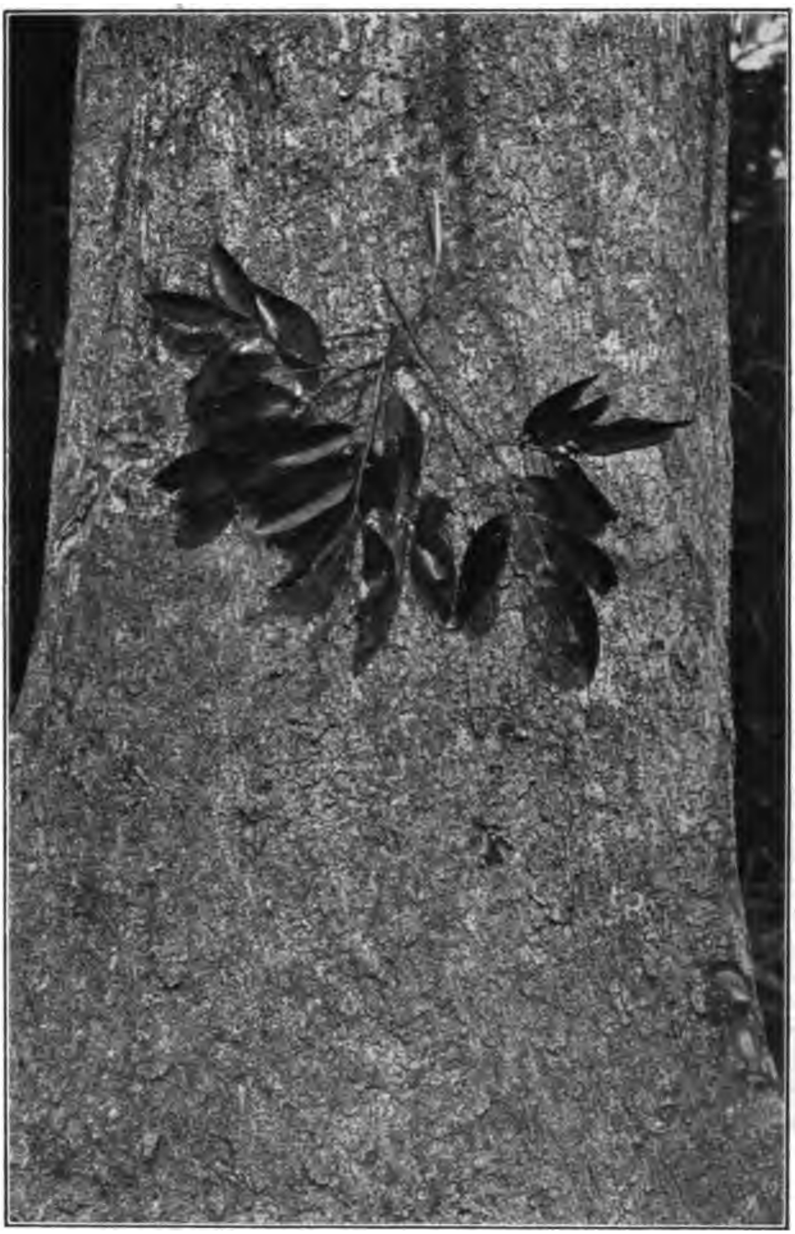

FIGURE 17. BARK AND LEAVES OF DIPTEROCARPUS GRANDIFLORUS (APITONG), A SOURCE OF BALAU.

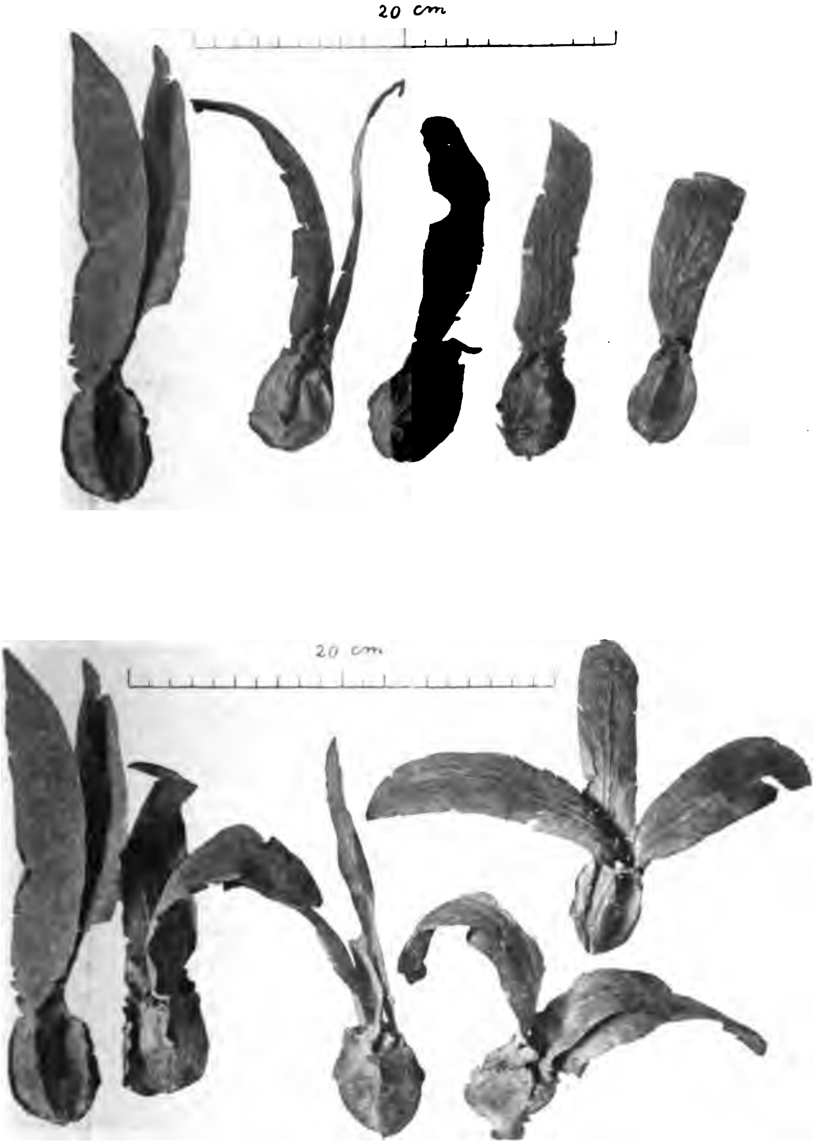

FIGURE 18. FRUITS OF DIPTEROCARPUS GRANDIFLORUS (APITONG).

a light yellow color and the characteristic odor of baláu. Treatment with sodium shows that it contains no alcoholic substances. Although it reacts with halogen acids, it was not possible to separate out a crystalline substance such as a hydrochloride. As the range in the boiling point of baláu is considerably greater than that of a pure chemical compound, it is probably a mixture of sesquiterpenes.

Bacon * performed a number of experiments to determine the solubility of baláu in various solvents. He also distilled the resin and separated the distillate into various fractions. Dr. M. V. del Rosario made determinations on these fractions and obtained the results recorded in Table 6.

TABLE 6.—*Constants of fractions of Baláu.*

No.	Specific gravity. $\frac{20^\circ}{4.^\circ}$	Index number.	Saponification number.	Acid number.
1	0.9089	268.3	4.01	1.8
2	0.8882	192.1	10.7	23.0
3	0.9387	120.9	12.75	18.0

Dipterocarpus grandiflorus reaches a height of from 40 to 45 meters and a diameter of 180 centimeters. The bole is straight and regular and from 25 to 30 meters in length. The bark is from 6 to 8 millimeters thick, and is brittle. It varies in color from a brown gray to a light gray. It is shed in large scroll-shaped plates and has numerous corky pustules. The inner bark has a reddish color. The leaves are alternate, leathery, smooth, pointed at the tip, usually rounded at the base, from 19 to 30 centimeters in length, and from 9.5 to 17 centimeters in width. The flowers are about 5 centimeters long, rose-colored, fragrant, and borne on racemes having about four flowers. The fruit is about 5 centimeters long, with five winglike projections from the sides, and at one end two wings which are 14 to 23 centimeters long and 3 to 5 centimeters wide.

The wood is moderately hard to hard, stiff, and strong. The heartwood is light ashy red to reddish brown or dark brown. It is used for posts; beams, joists, rafters; flooring; bridge and wharf constructions except piles; wagon beds; ship planking, barges and lighters; ties, paving blocks, mine timbers; cheap and medium-grade furniture.

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* Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), page 93.

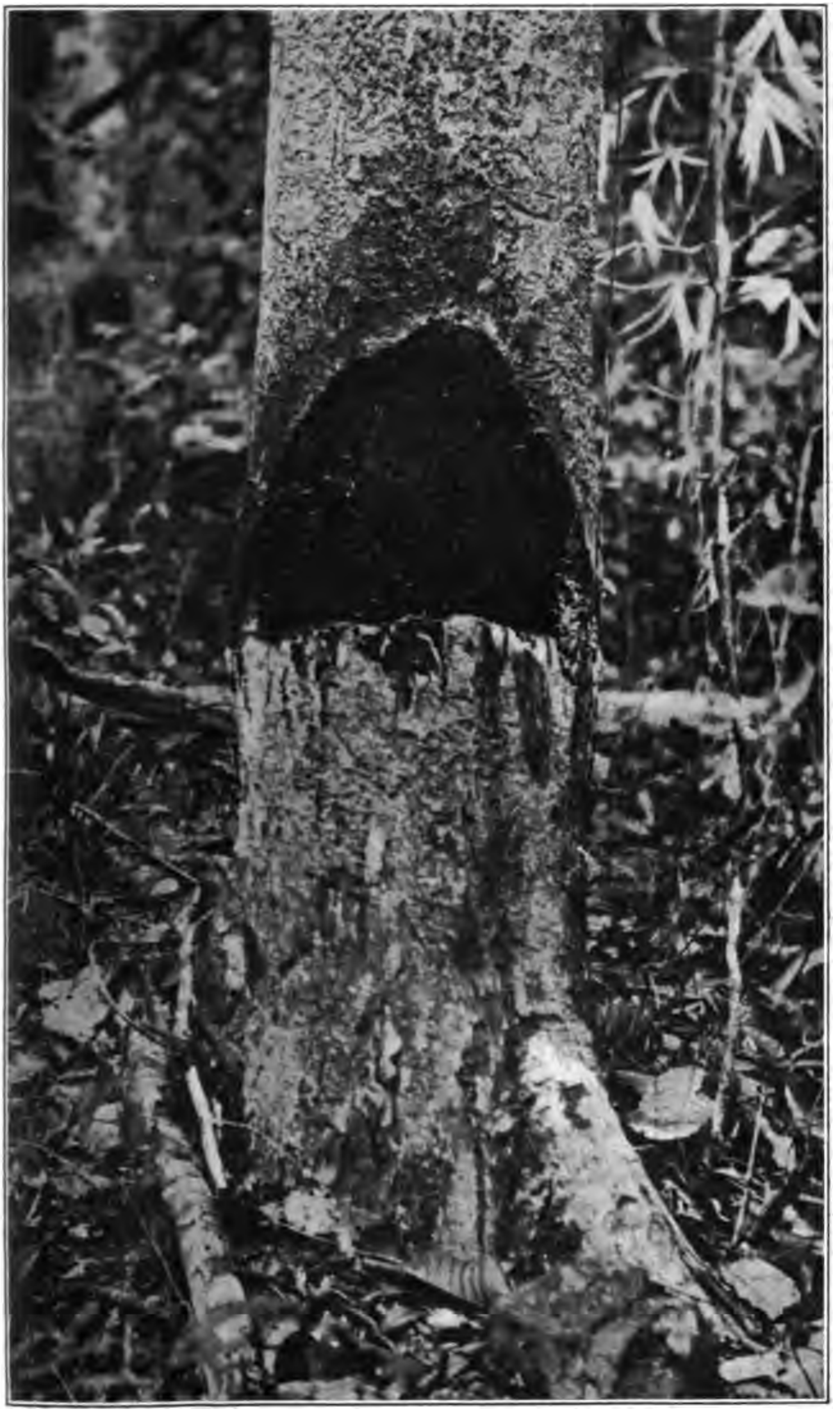

FIGURE 19. DIPTEROCARPUS GRANDIFLORUS (APITONG) BOXED FOR RESIN.

Apitong is the most generally used construction wood in the Islands. It is apparently impossible to distinguish commercially between the wood of the different species of *Dipterocarpus* and that of all the species known commercially as apitong. Apitong is the most abundant wood in the Philippine Islands, composing, according to Foxworthy,* 20 per cent of the volume of our commercial forests.

Dipterocarpus grandiflorus is found throughout the Philippine Archipelago, and has been reported from the following localities: Palaui Island, Cagayan, Isabela, Apayao, Benguet, Ilocos Sur, Pangasinan, Abra, Nueva Vizcaya, Nueva Ecija, Zambales, Bataan, Bulacan, Rizal, Laguna, Tayabas, Camarines, Mindoro, Capiz, Sibuyan Island, Albay, Samar, Negros, Palawan, Misamis, and Agusan. It is especially plentiful in regions where the dry season is pronounced.

DIPTEROCARPUS VERNICIFLUUS Blanco. (Figs. 20–22). PÁNAU.

Local names: *Afú* (Ilocos Norte); *apítong* (Mindoro, Polillo, Bataan, Tayabas, Marinduque, Leyte, Laguna, Samar); *baláu* (Rizal, Zamboanga); *dúen, lamílan* (Isabela); *gan-án* (Camarines); *kalusúban* (Ilocos Sur); *kamúyau, kurimau, pagsaín͠gin, pamarnísen* (Cagayan); *lauán* (Negros, Rizal, Nueva Ecija); *lipót* or *lipús* (Agusan); *lipús* (Surigao); *malapáho* (Polillo); *matatalína* (Zamboanga); *padsahín͠gin* (Laguna); *pamantúlen* (Pangasinan); *pánau* (Rizal, Palawan, Bataan, Zambales, Bulacan, Pangasinan, Davao, Cotabato, Cagayan, Laguna, Pampanga, Tayabas, Nueva Ecija.)

BALÁU (PANÁU) RESIN

Oil obtained from the trunk of this species is very similar to baláu from *Dipterocarpus grandiflorus*, is used for the same purposes, and is regularly called baláu. This oil is also known as oil of pánau, and sometimes as malapaho.

Clover,† who investigated the chemical properties of oil of pánau states that the method of obtaining this oil from the tree is the same as that used in the case of baláu. It is reported that a gallon per day is sometimes obtained. The fresh resin is a white, viscous, sticky fluid having a characteristic odor by which it is distinguished from similar products. When exposed to the air, oxygen is absorbed and the color gradually turns brown. It hardens very slowly when exposed in a thin film. It is insoluble in water, but dissolves in ether or chloroform with the separation of water. When distilled with a free flame it acts

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* Foxworthy, F. W., Philippine Dipterocarpaceae, II. Philippine Journal of Science, Section C, Volume 13 (1918), page 163.

† Clover, A. M., Philippine wood oils. Philippine Journal of Science, Section A, Volume 1 (1906), page 198.

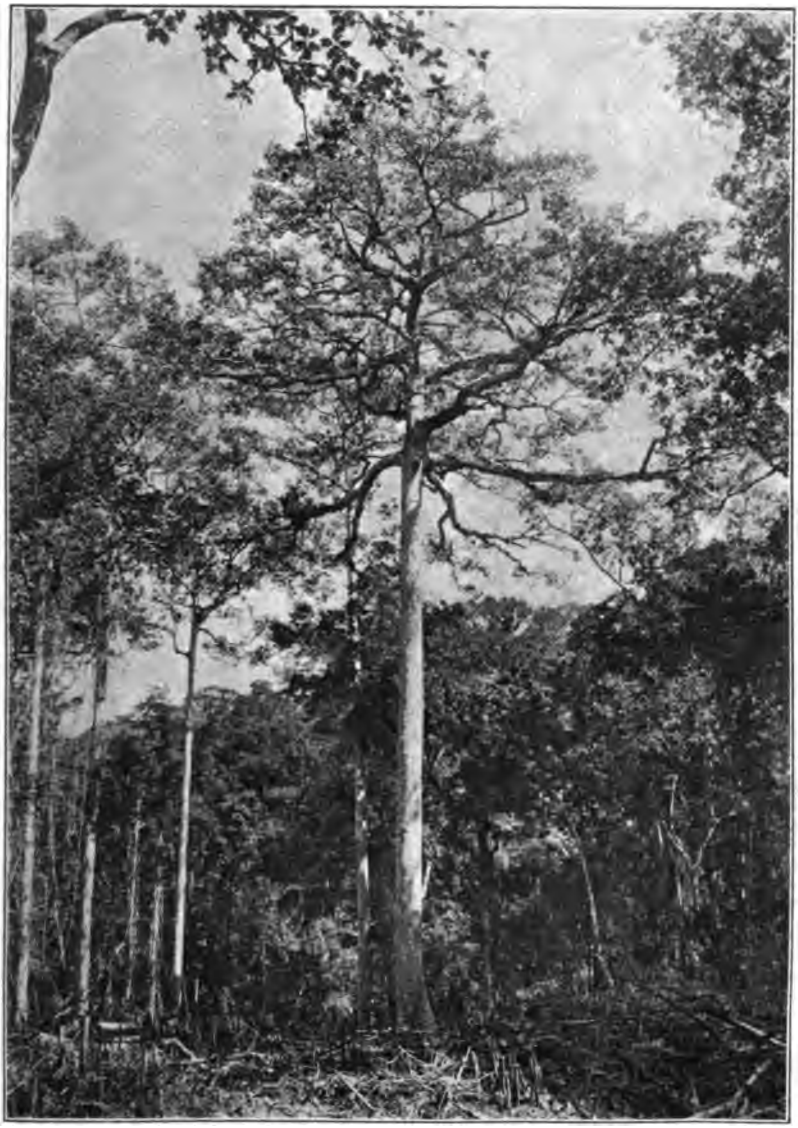

FIGURE 20. DIPTEROCARPUS VERNICIFLUUS (PANAU), A SOURCE OF BALAU.

like baláu and yields about 25 per cent of water, 35 per cent of oil, and 40 per cent of solid residue. It probably consists of water, sesquiterpene oils, and solids.

Dipterocarpus vernicifluus reaches a height of 40 to 45 meters and a diameter of 160 to 180 centimeters. The bole is straight, regular, and reaches a length of 28 to 32 meters. It usually has very prominent buttresses. The bark is from 5 to 8 millimeters thick, light brown to gray in color, scaling in large patches, and is covered with numerous corky pustules. The inner bark is brown to reddish brown and stringy in texture. The young stems and the midrib and secondary nerves of the leaves are covered with long hairs. The leaves are alternate, leathery, pointed at the tip, rounded at the base, from 10 to 23 centimeters long, and 6 to 13 centimeters wide. The flowers are about 4 centimeters long, white, tinged with pink, and very fragrant. The fruits are rounded, about 1.5 centimeters in diameter and bear two long wings which are about 12 centimeters in length and 2 or 3 centimeters in breadth. The wood is very similar to that of *Dipterocarpus grandiflorus* and has the same uses.

This species abounds in regions with a pronounced dry season and has been reported from the following localities: Cagayan, Isabela, Ilocos Norte, Ilocos Sur, Pangasinan, Zambales, Nueva Ecija, Pampanga, Bulacan, Bataan, Rizal, Laguna, Tayabas, Camarines, Marinduque, Polillo, Negros, Samar, Leyte, Palawan, Misamis, Surigao, Agusan, Davao, Cotabato, and Zamboanga.

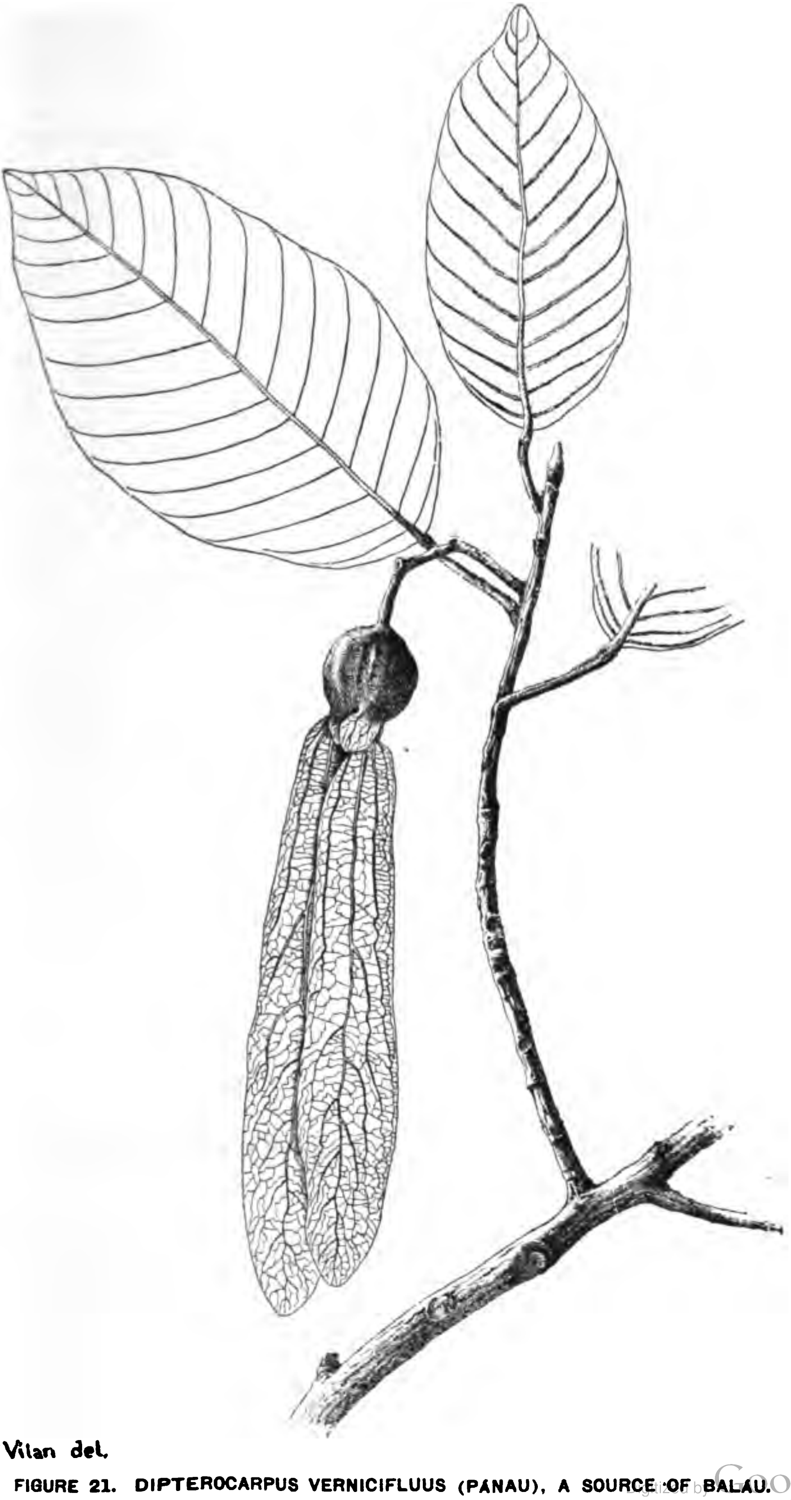

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FIGURE 21. DIPTEROCARPUS VERNICIFLUUS (PANAU), A SOURCE OF BALAU.

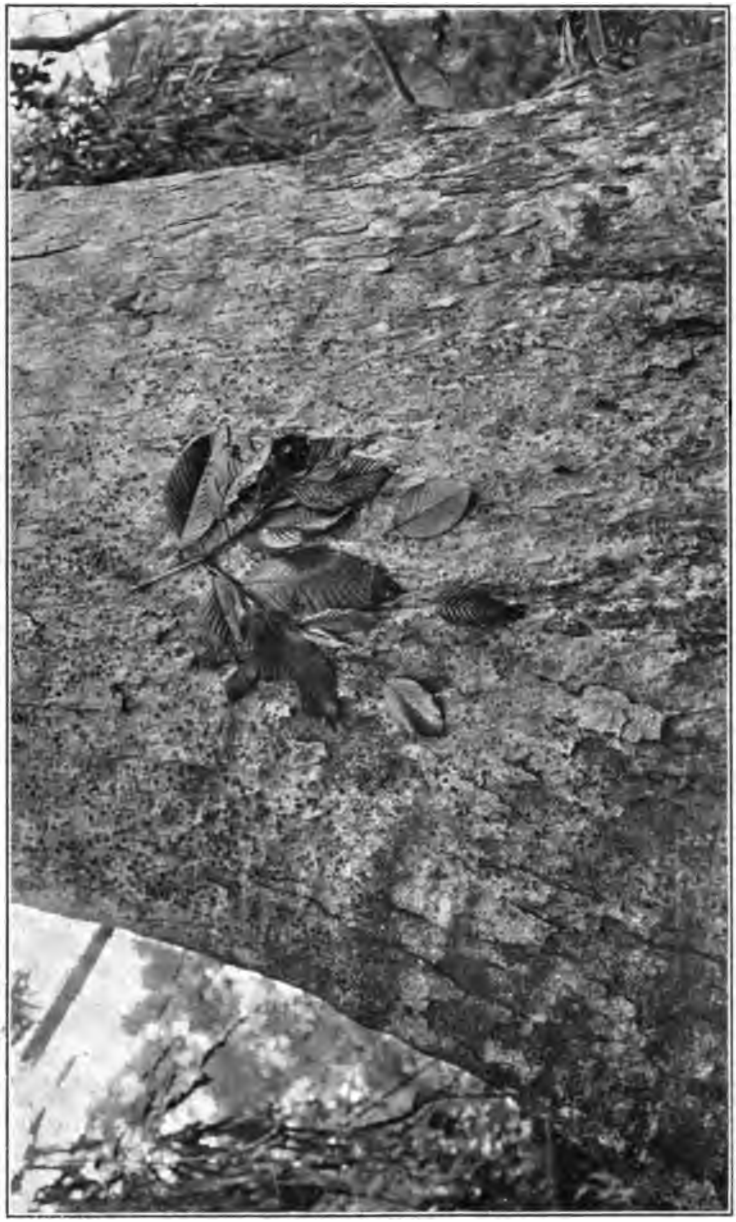

FIGURE 22. BARK AND LEAVES OF DIPTEROCARPUS VERNICIFLUUS (PANAU), A SOURCE OF BALAU.

GUMS

Gums are amorphous substances which exude from plants or which may be extracted by solvents. The true gums, such as acacia and tragacanth, have the property of either dissolving in water or taking up a sufficient amount of water to become glutinous and form a sticky liquid (mucilage). There are, however, a number of well-known substances like rubber and gutta-percha, which resemble the true gums, but are insoluble in water. Substances of this nature are obtained from plants which have capillary tubes containing a milky juice. This juice (latex) may occur in the stems, leaves, or roots. The latex appears to be an emulsion which contains a number of substances in varying proportions. An idea of the composition of one of these milky juices may be obtained from the following figures * which represent the analysis of the latex of *Hevea braziliensis*, the plant from which para rubber is obtained.

	Per cent.
Water	55.0
Rubber	38.5
Proteins	3.0
Resins	3.0
Mineral matter	0.5

The latex may be obtained by making incisions in the trunk of the tree. This cuts the latex tubes and allows the milky juice to exude. The juice thus obtained is collected in small vessels and may be coagulated in various ways, such as by smoking or by treatment with a salt solution. The latex may also be extracted by other mechanical or chemical methods.

The most important substances produced in the Philippines which may be classified as gums are rubber and gutta-percha. The wild rubber is small in amount, and the native plants do not appear to offer any prospect for a considerable industry. The southern Philippines seem, however, to be well suited for the production of plantation rubber, and the rates of growth of *Hevea braziliensis* in this region compare favorably with rates elsewhere.†

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* Rogers, A., Industrial chemistry, 1915, page 704.

† Yates, H. S., The growth of Hevea braziliensis in the Philippine Islands. Philippine Journal of Science, Volume 14 (1919), pages 501–523.

In the Philippines very little rubber has yet been planted, despite the fact that the United States is the world's greatest consumer of crude rubber. The imports of crude rubber into the United States for the fiscal year ending June 30, 1917, were 151,533,505 kilos valued at ₱378,657,348.‡ The imports from the British and Dutch East Indies for the same period were 82,468,900 kilos valued at ₱208,451,104. At the present time practically all the plantation rubber produced in the Philippines is grown on one plantation in the Island of Basilan. Several other plantations are, however, beginning to produce rubber.

Large quantities of gutta-percha have been collected in the southern Philippines, and at the present time gutta-percha, obtained from wild species, is still being exported. However, as in the case of rubber, no very considerable industry can be expected until the trees are grown in plantations.

The next most promising Philippine gums would seem to be those which form the basis of chewing gum. Two native species of *Artocarpus* appear worthy of note in this respect, while *Achras sapota* (chico), the source of gum chicle, is grown extensively throughout the Archipelago for its edible fruits. Gum chicle is exported in enormous quantities from Mexico to the United States, where it is the principal substance used in the manufacture of chewing gum. In the Philippines this product has apparently never been collected.

Family ORCHIDACEAE

Genus GEODORUM

GEODORUM NUTANS (Presl) Ames.

Local names: *Bandabok* (Palawan); *cebollas del monte* (Cavite); *kula* (Manila); *lubi-lubi* (Negros).

GEODORUM NUTANS GUM

The tuberous roots contain a substance which is used as a glue, especially in cementing together parts of mandolins, guitars, and other musical instruments. In preparing the glue the rhizomes are first cooked and then finely grated. Glue thus prepared is said to have great tenacity.

Several other Philippine orchids are used for the same purpose.

Geodorum nutans is a terrestrial orchid with somewhat fleshy underground roots. It reaches a height of 70 centimeters. The

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‡ India Rubber World, Volume 57 (1917), page 59.

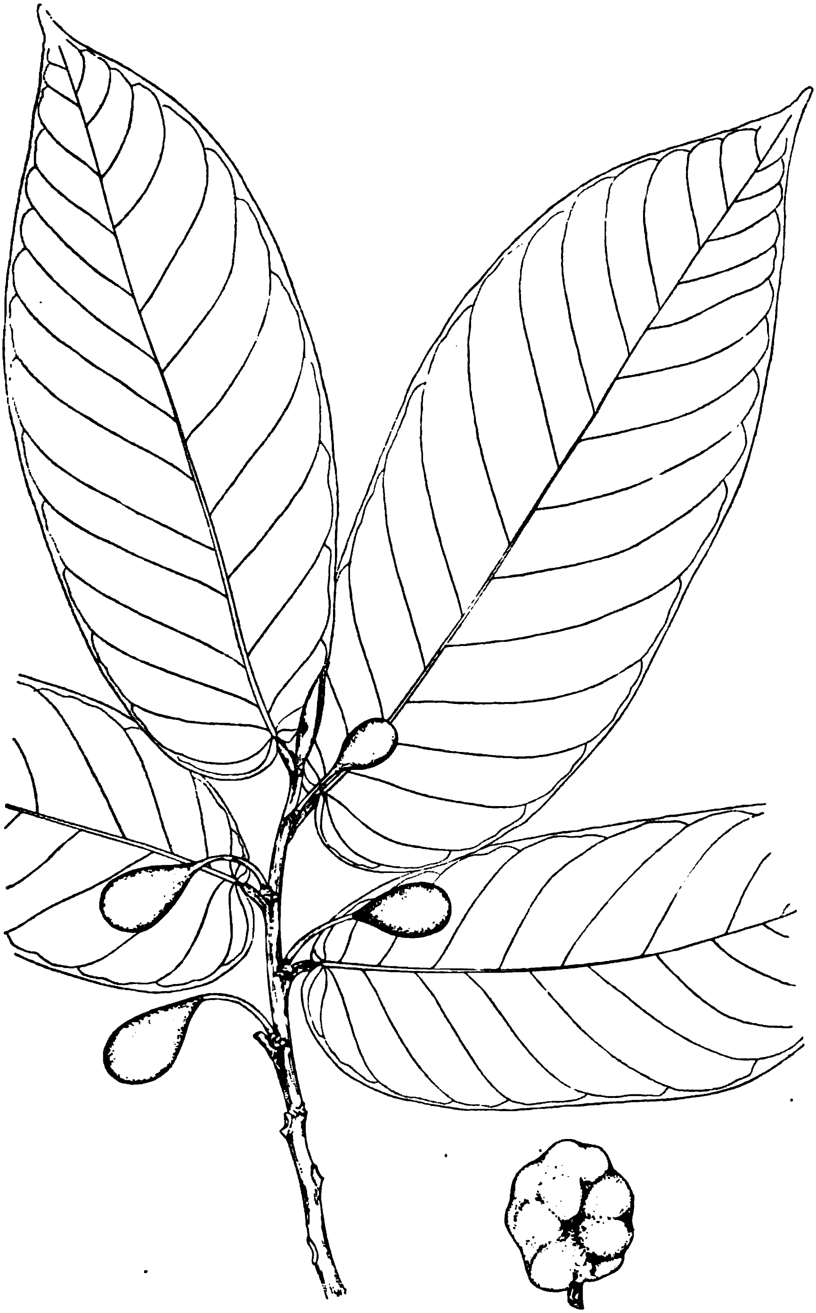

FIGURE 23. ARTOCARPUS CUMINGIANA (ANUBING), A SOURCE OF CHEWING GUM. ×½.

shoot bears two or four large leaves, which are variable in size. The leaves are rather narrow, pointed, and up to 35 centimeters in length and 7 centimeters in width. The flowering shoots are 20 to 25 centimeters in length and leafless. The flowers are pale pink to purple, about 1 centimeter long and numerous.

This species is widely distributed in the Philippines and is also found in Formosa. It occurs particularly in thickets and open places.

Family MORACEAE

Genus ARTOCARPUS

ARTOCARPUS CUMINGIANA Tréc. (Fig. 23). ANUBÍNG.

Local names: *Anubíng* (Nueva Ecija, Tarlac, Zambales, Rizal, Laguna, Tayabas, Camarines, Sorsogon, Mindoro, Nueva Ecija, Sibuyan); *anublíng* or *kanublíng* (Camarines, Albay, Sorsogon); *bayukó*, *isís* (Negros, Iloilo); *kalauáhan* (Bontoc); *kamandág* (Cagayan); *koliúng* (Abra); *kúbi* (Tayabas, Mindoro, Masbate, Ticao, Negros, Surigao); *obién* or *ubién* (Abra, Ilocos Sur, Isabela, Benguet, Union).

ANUBÍNG GUM

The latex of this species would appear to be promising material for chewing gum.

This species has been grown in plantations at Los Baños. Two separate lots of seeds were planted. In one case the percentage of germination was 61.7 and in the other 28.7. At the end of 7 years the average rate of growth was 2.5 meters.

Artocarpus cumingiana is a tree reaching a height of about 30 meters and a diameter of about 100 centimeters. The leaves are alternate, hairy, pointed or slightly heart-shaped at the base, and average 20 centimeters long, and 10 centimeters wide. The petioles are 1 to 2 centimeters long. The male heads are pear-shaped and 1 to 2 centimeters long. The female heads are rounded and nearly 2 centimeters in diameter.

This species is distributed from northern Luzon to Mindanao.

ARTOCARPUS ELASTICA Reinw. (Fig. 24). GUMÍHAN.

Local names: *Antipólo* (Tayabas, Samar); *gumíhan* (Camarines, Albay, Sorsogon); *tugúp* (Surigao, Davao).

GUMÍHAN GUM

The latex of this tree hardens into a somewhat brittle substance resembling in color and consistency the stick chewing gum put on the market years ago, before it was blended with sugar and flavored. As far as is known, the gum of *Artocarpus elastica* has not been collected in quantity nor has any analysis been made of it. The latex of some species of *Artocarpus* is used locally in compounding bird lime.

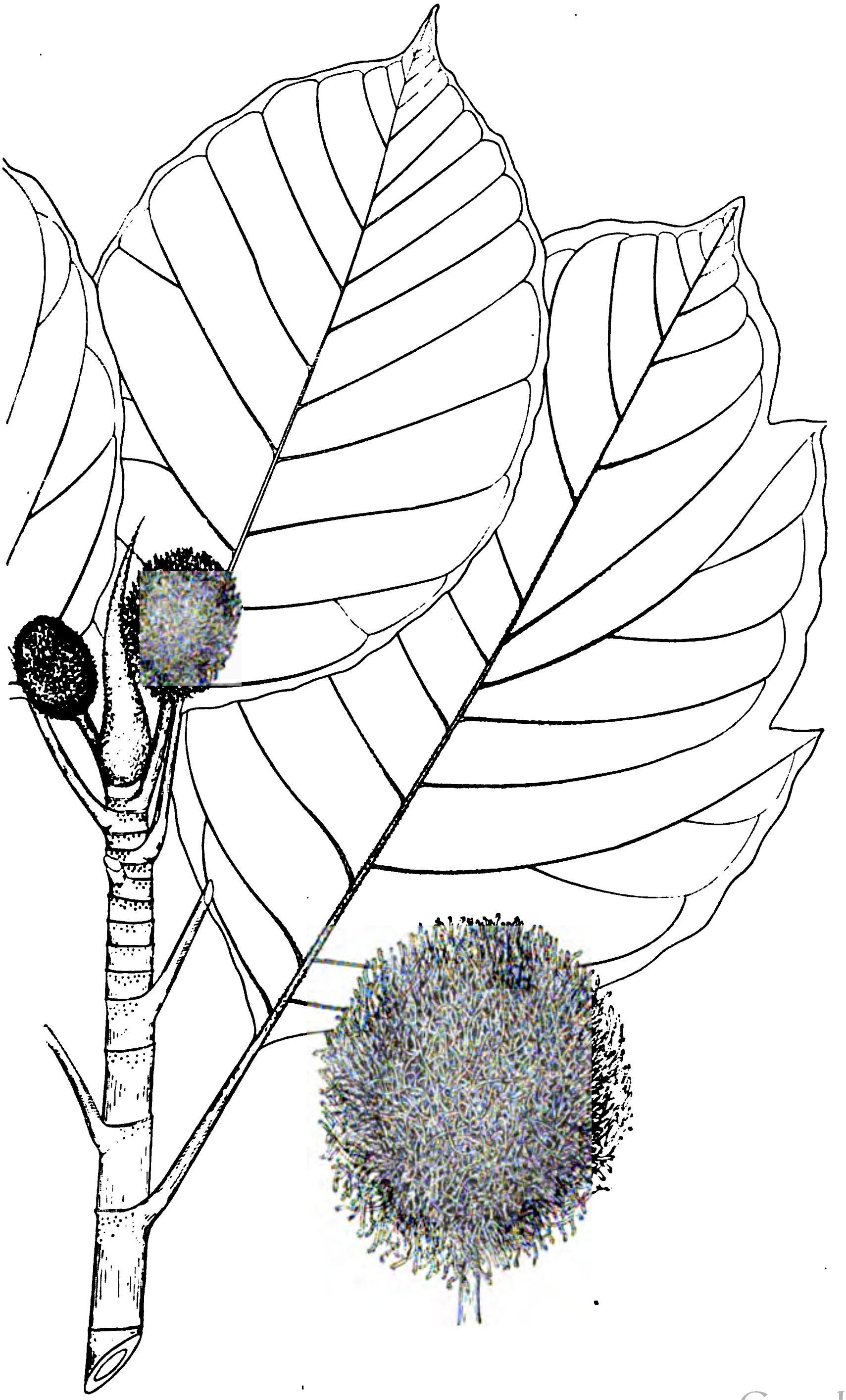

FIGURE 24. ARTOCARPUS ELASTICA (GUMIHAN), A SOURCE OF CHEWING GUM. ×½.

Heyne * reports that oil from the seeds of *Artocarpus elastica* is used in cooking and as a hair oil.

Artocarpus elastica is a stately tree with trunks 60 to 90 centimeters in diameter. The leaves are alternate, crowded, obtuse at both ends, occasionally lobed towards the apex, the larger ones 20 to 30 centimeters wide, and 60 to 90 centimeters long. The male spikes are cylindrical, oblong, soft or spongy, and yellowish. The female heads are somewhat rounded or elliptical. The fruit is heavy, at least 10 centimeters long, and covered with brownish, hairy appendages. The seeds are embedded in whitish, more or less gummy pulp of a delicious tart flavor. They resemble peanuts, and when roasted have a similar flavor.

There are about twenty species of the genus *Artocarpus*, all having latices which resemble those of anubing and gumihan, and which are used for various purposes such as making birdlime and other sticky substances.

Family LEGUMINOSAE

Genus ACACIA

ACACIA FARNESIANA Willd. ARÓMA.

The gum of this species is mentioned under the heading of essential oils.

Genus SESBANIA

SESBANIA GRANDIFLORA Pers. KATÚRAI.

Local names: *Diana* (Davao); *katúri* (Pampanga, Tayabas); *katúdai* (Ilocos Norte and Sur, Abra, Nueva Vizcaya, Pangasinan, Union); *katúrai* (Cagayan, Pangasinan, Tarlac, Bulacan, Zambales, Bataan, Rizal, Tayabas, Manila, Batangas, Laguna, Mindoro, Camarines, Zamboanga); *gauai-gáuai* (Manila, Camarines, Albay, Sorsogon, Capiz, Negros); *gaui-gáui* (Guimaras Island).

KATÚRAI GUM

This species produces a clear gum used locally as a substitute for gum arabic. The flowers and young fruits are cooked and eaten as vegetables.

Sesbania grandiflora is a tree 5 to 10 meters in height. The leaves are alternate, 20 to 30 centimeters long, and pinnate with 20 to 40 pairs of leaflets, which are 2.5 to 3.5 centimeters long. The flowers are white and from 7 to 9 centimeters long. The pods are 20 to 60 centimeters long, 7 to 8 millimeters wide, somewhat curved, and contain many seeds.

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 2 (1916), page 49.

This species is not uncommon in cultivation in the Philippines, and is half wild.

Family EUPHORBIACEAE

Genus MACARANGA

MACARANGA TANARIUS Muell-Arg. BINÚÑGA.

Local names: *Alañgabun, anabun* (Bagobo); *bagambáng, ma-ásim* (Rizal); *bilúa* (Pampanga); *bilúan, binúñgan, malabúñga, biluán-lalúki* (Bataan); *bilúñga* (Tayabas); *biñg-úa* (Nueva Vizcaya); *binúñga* (Bataan, Bulacan, Rizal, Laguna, Camarines, Polillo, Mindoro, Guimaras Island, Negros, Palawan); *binuga, luñgakan,* (Davao); *gamu, sámuk* (Cagayan); *ginabang* (Benguet); *labauel* (Lepanto); *lagau* (Bisaya); *lagaon, ligabon* (Manobo); *malabúñga* (Mindanao); *mindáng* (Camarines); *minúñga* (Agusan); *sámak* (Ilocos Norte, Abra, Camiguin Island).

BINÚÑGA GUM

A glue used for fastening together the parts of musical instruments such as guitars, violins, etc., is obtained from the bark of this tree. The bark is tapped by V-shaped incisions, and the sap collected and used shortly afterwards. It is said that if the sap is allowed to stand until it becomes sticky, it is worthless for the above-mentioned purposes. Heyne * mentions a similar use in Java.

Macaranga tanarius is a small tree reaching a height of 4 to 8 meters. The leaves are alternate, 10 to 25 centimeters long, shield-shaped, with the petiole attached to the lower surface within the margin.

This species is very common and widely distributed in open places and second-growth forests throughout the Philippines.

Family SAPOTACEAE

Genus ACHRAS

ACHRAS SAPOTA L. CHÍCO.

CHICLE GUM

Gum chicle, which is the principal substance used in the manufacture of chewing gum, is derived from the bark of this plant. In the Philippines, *Achras sapota* is extensively grown for its edible fruits known as chicos. No gum chicle is produced locally, although it would seem that it might be a profitable industry. The following short account of gum chicle is taken from the National Standard Dispensatory.†

Somewhat like Gutta-percha in its general nature is Chicle, or Gum

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 3 (1916), page 86.

† National Standard Dispensatory (1905), page 751.

Chicle, now the principal substance used in the manufacture of chewing-gum, and derived from *Achras Sapota* L. (*Sapota Achras* Mill., the *Sabodilla, Sapotilla, White sapota, Naseberry*, or *Ya*, of tropical America, where this tree supplies one of the most important edible fruits. Although the substance is collected in many parts of Mexico and Central America, the principal sources of supply are in Yucatan. The milk-juice is obtained from incisions made in the bark, performed with great care and by experienced persons. Tapping may occur once in 3 years without great danger to the life of the tree. The raw milk is boiled and then allowed to harden in brick-shaped moulds. If carefully prepared, it usually turns out of a white or whitish color, though that of some trees is said to turn out red in any case, a result which will also occur if the ordinary milk be overcooked. If undercooked, it retains a large percentage of water, proportionately reducing its value. Various devices for adulterating substances of this class are resorted to. Chicle gum of good quality is whitish, of firm, tenacious, somewhat elastic consistency, yet may be crumbled between the fingers; somewhat aromatic and nearly tasteless. It becomes plastic on chewing. Examined by Prochozka and Endemann, 75 per cent was found to be a resin, 9 per cent calcium oxalate (with traces of magnesium sulphate).

Concerning gum chicle, Hyde * states that:

> * * * The best grades are nearly white and clean, but, if overheated, a red gum is produced. Consists of an oxidized hydrocarbon, closely related to caoutchouc. Softens in the mouth, and is tasteless but aromatic when heated. Sp. gr. 1.05. Soluble in chloroform, carbon tetrachloride, benzine, and somewhat in alcohol.
>
> *Uses.*—Transmission belts, dental surgery, substitute for gutta percha, and more especially for chewing-gum.

According to Rogers,† the trees yield about six to eight pounds of gum. Most of the chicle imported into the United States is used in making chewing gum. For this purpose, washed and dried chicle is mixed with flavoring materials and fragrant oils.

Dannerth ‡ gives detailed methods for analyzing the crude gum. An idea of its composition may be obtained from the following figures (Dannerth) showing the analysis of a sample from Yucatan:

	Per cent.
Aceton-soluble matter (resins)	40.00
Gutta (and carbohydrates)	17.40
Proteins	0.60
Sand and foreign matter	2.30
Water	35.00
Mineral matter (ash)	4.70

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* Hyde, F. S., Solvents, oils, gums, waxes and allied substances (1913), page 41.

† Rogers, A., Industrial chemistry (1915), page 722.

‡ Dannerth, F., Journal of Industrial and Engineering Chemistry, Volume 9 (1917), page 679.

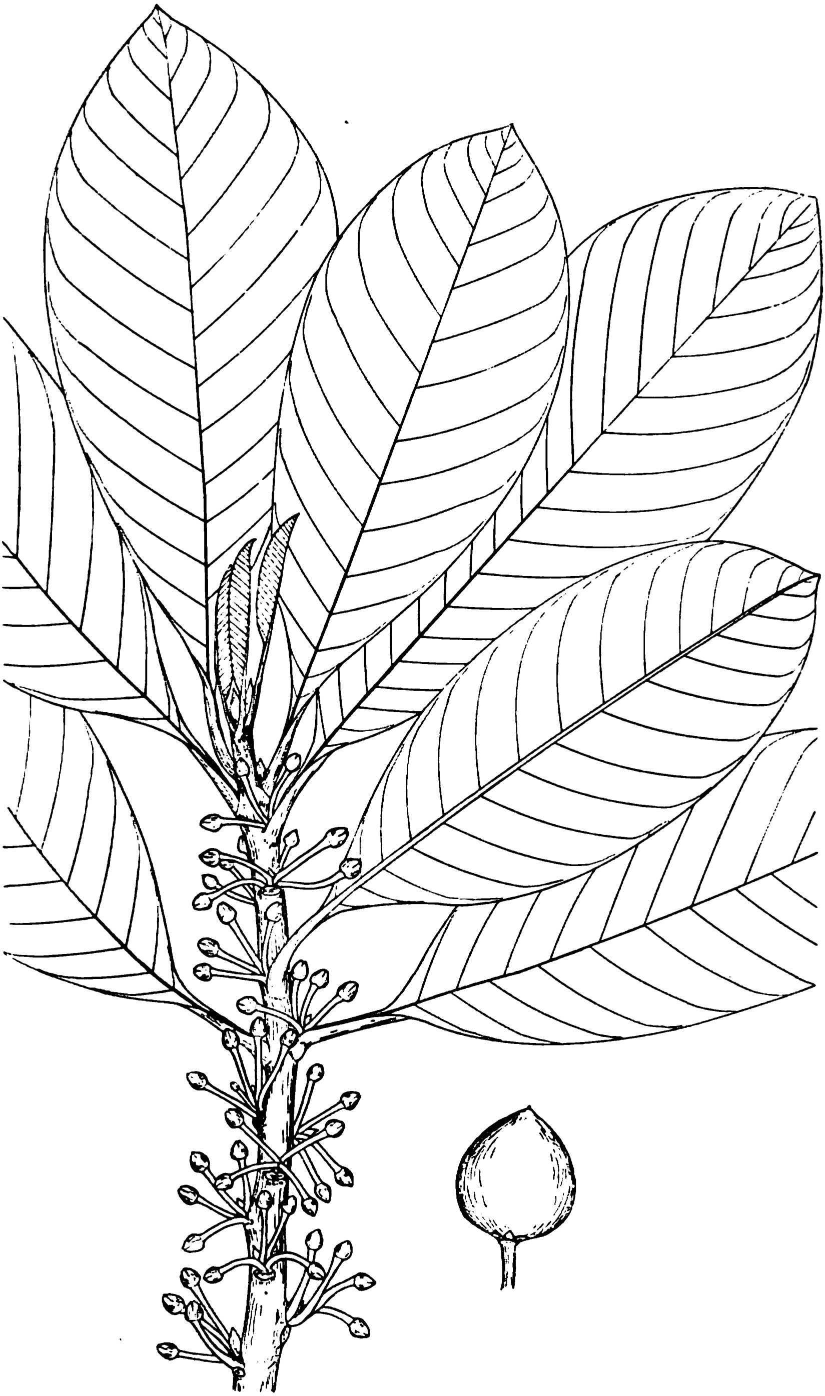

FIGURE 25. PALAQUIUM AHERNIANUM (KALIPÁYA), A SOURCE OF GUTTA-PERCHA. ×⅓.

Dannerth says that in 1916 approximately 7,347,000 pounds of chicle were imported into the United States. This is equivalent to about 30,000,000 pounds of chewing gum.

Genus **PALAQUIUM**

PALAQUIUM AHERNIANUM Merr. (Figs. 25–28). KALIPÁYA.

Local names: *Kalapía, kalipáya* (Zamboanga); *salikút* (Surigao); *salukút* (Bukidnon).

GUTTA-PERCHA

A number of species of this genus produce gutta-percha. The Philippine species containing gutta-percha are numerous, but in most cases the grade is apparently too poor to make its collection profitable. The best known of the Philippine gutta-percha trees is *Palaqium ahernianum.* In the Philippines, commercial gutta-percha is apparently confined largely, if not entirely, to Mindanao and Tawi-Tawi. Here gutta-percha trees formerly existed in considerable numbers, but the method of collection has resulted in the destruction of the trees until, at the present time, the supply in accessible regions has been almost entirely depleted. Formerly considerable quantities of gutta-percha were exported from the Philippines, but now the amount exported is small. In Table 7, are given the exports for the years 1915 to 1918.

TABLE 7.—*Amount and value of gutta-percha exported from the Philippine Islands for the years 1915 to 1918.*

Year.	Amount.	Value.
	Kilograms.	*Pesos.*
1915	31,650	31,143
1916	29,962	22,898
1917	14,359	11,640
1918	2,334	2,007

Although the potential supply has been greatly depleted, the amount exported would increase considerably if the collectors received a higher price. At the present time gutta-percha is collected in a desultory manner and sold to Chinese merchants at a small price. It then passes through several hands and most of it finally reaches Singapore.

According to Sherman,* who made an extensive study of

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* Sherman, Jr., P. L. The gutta-percha and rubber of the Philippine Islands. Bureau of Government Laboratories Publication No. 7 (1903), page 7.

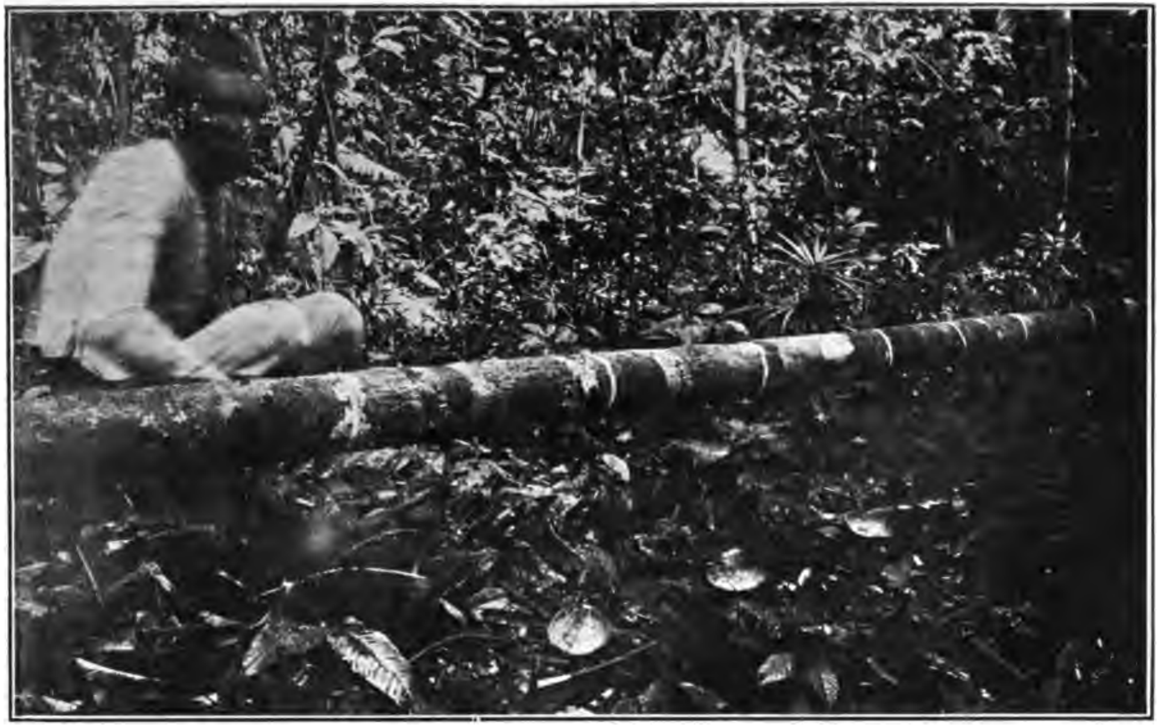

FIGURE 26. TAPPING A GUTTA-PERCHA TREE IN SUCH A MANNER THAT ALL THE MILK IS COLLECTED IN SHELLS BENEATH AND NONE LOST. DONE BY MOROS IN TAWI-TAWI.

gutta-percha in the Philippines, the usual method of collection is as follows:

> * * * The tree is first cut down and the larger branches at once lopped off, the collectors say to prevent the gutta-percha milk from flowing back into the small branches and leaves. As has been previously stated the milk or latex is contained in the layers of the bark and leaves, in small capillary tubes or ducts. . . To open these so as to permit the maximum amount of the milk to escape, the natives cut rings in the bark about two feet apart along the entire length of the trunk. The milk as it flows out is collected in gourds, coconut shells, large leaves, or in some districts in the chopped-up bark itself, which is left adhering to the tree for the purpose of acting as a sort of sponge. * * *. After one or two hours, when the milk has ceased to flow, the contents of the receptacles are united and boiled over a fire for the purpose of finishing the partial coagulation. The warm, soft mass is then worked with cold water until a considerable amount of the liquid is mechanically inclosed. To further increase the weight, chopped bark, stones, etc., are added and the whole mass worked into the required shape with most of the dirt on the inside.

Sherman characterizes this method as very wasteful, since the tree usually falls in such a way that it is not possible to ring the trunk on all sides. He says:

> * * * As a general thing from one-third to one-half of it is inaccessible to the process of ringing, and all the milk within this portion is consequently lost. Even the larger limbs are not deemed worth ringing and consequently all the milk in them and in the leaves also goes to waste; to this must be added the considerable quantity spilled on the ground through carelessness and lack of enough receptacles for every cut or bruise from which the milk flows.

Furthermore, no matter how much cutting is done, all of the milk will not flow from the trunk. Sherman collected a measured quantity of bark, after no more gutta-percha could be collected by the method described above, and extracted all of the gutta-percha which it contained. From this he estimated that ten times more gutta-percha was left than collected. Perhaps an even greater disadvantage of the usual method of collection is that it destroys the trees and therefore reduces the potential supply. Concerning this point Sherman states:

> It is fortunate that only the full-grown trees contain enough gutta percha to repay the work of felling, ringing, etc.; otherwise the complete extermination of the gutta-percha forest would only be a matter of a year or so. On the other hand the felling of all the trees old enough to bear seed works to the same end with a somewhat longer time limit.

Gutta-percha is cleaned by the Chinese merchants, who ship it to Singapore. The account of this process given below is taken from a report by W. I. Hutchinson, formerly of the Bureau of Forestry:

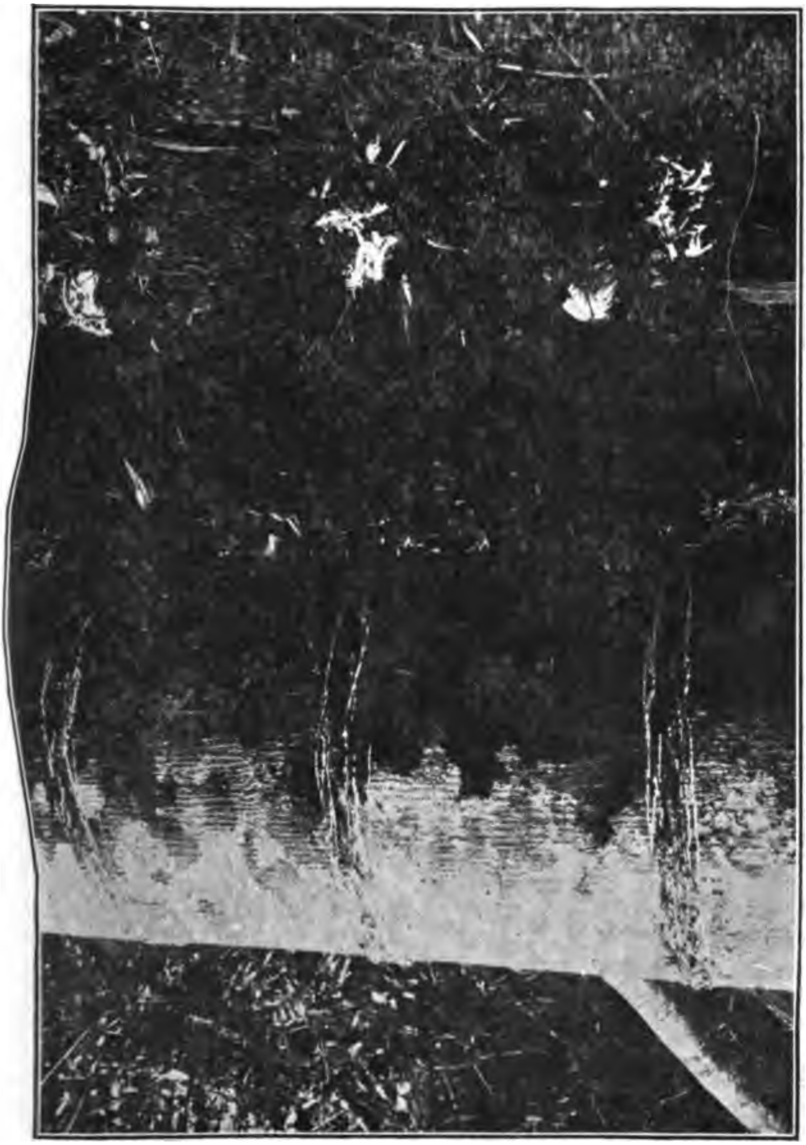

FIGURE 27. A GUTTA-PERCHA TREE TAPPED IN SUCH A MANNER THAT THE FLOWING MILK IS NOT ALL ABSORBED BY THE CHOPPED-UP BARK, BUT MUCH OF IT IS LOST ON THE GROUND BELOW. TUCURAN, DISTRICT OF ZAMBOANGA, MINDANAO.

The classification of gutta-percha depends largely on its flexibility, and freeness from bark and other forms of dirt. The first class product is almost pure white in color, and contains but a small amount of foreign matter. The second and third class gum has a pinkish tinge the amount of bark, stones, sticks, etc. varying from 20 per cent to 50 per cent or more.

First class or white gutta is rarely worked over, but the inferior grades are almost always subjected to a cleaning process before being shipped, on account of the low price that "dirty" gutta commands in the Singapore market.

The first step in the cleaning process is, to cut or tear the balls or rolls of gutta into small pieces. If the rolls are large they are often placed in hot water and allowed to soften slightly, in order to facilitate the separation of the sheets or strips.

As soon as a large amount of the product has been thus prepared, a fire is kindled under a stone oven, in the top of which a large caldron, three feet or more in diameter, has been sunk. This caldron is filled two-thirds full of water, the "scrap" gutta dumped in, and the whole mass allowed to boil until the gum becomes soft and stringy.

After boiling for a short time the bark contained in the "scrap" colors the water a deep blood-red-brown, and stains the softened gutta a pinkish tinge. Some of the Chinos add varying quantities of salt to the liquid, probably "to set" the color, although they one and all deny that this is the reason.

When the gutta is soft enough to be worked, it is dipped out with a bejuco sieve or a shovel, five or six quarts being placed in a heap upon a broad flat board. Over this steaming mass a sack is thrown, upon which a native, after dipping his feet in cold water, treads, thus causing the gum to spread out in a broad, flat sheet. If there is considerable dirt present it is usual to work over the mass with a large meat fork or a paddle, shaking out as much of the bark, etc., as possible.

As soon as the forking process is finished, tramping is again resorted to, this time without the sack. When the gutta has again been worked into a sheet, water is thrown upon it, a native meanwhile brushing it vigorously with a stiff broom, and occasionally removing a large piece of dirt with his hands.

While the sheet is being turned over, the board on which it has been resting is either brushed or washed clean.

Tramping is done altogether with the heels, the men maintaining their balance by holding to a rope stretched, some five feet above the ground, in front of the board.

After a time when the gutta becomes too hard to be dented by the heel, wooden mallets, or sticks similar to those used by the natives in hulling rice, are employed for beating.

At the completion of each tramping or beating operation, a sheet 2 ft. wide, 3 ft. or more in length, and 1 in. thick, is obtained, which is folded into as small a roll as possible, preparatory to the next tramping.

The cleaning operation being finished, the sheet is folded into an oblong mass, 12 in. long, 6 to 8 in. wide, and 5 in. thick, having a weight of from 8 to 12 pounds.

Three men, who receive a peso a day each, two working on the gutta and one carrying water, can clean three piculs per day.

Another method of cleaning gutta-percha is to boil it in

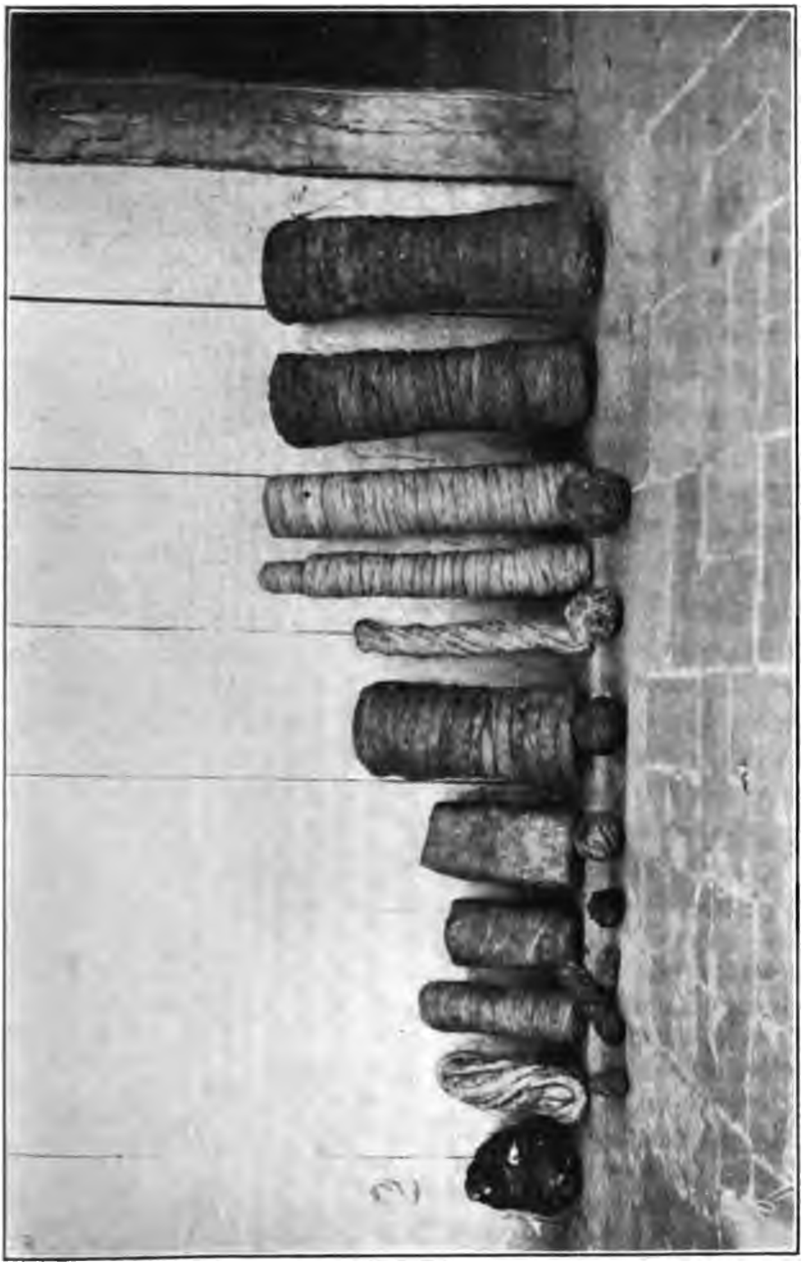

FIGURE 28. GUTTA-PERCHA AS IT REACHES THE MARKET.

water to which petroleum has been added. The petroleum is said to facilitate the removal of dirt and resin. After the first boiling the gutta-percha is ground and boiled again with water, the process being repeated several times. This method apparently results in a high-grade product.

Gutta-percha is now being grown successfully in plantations in a number of tropical countries, but not in the Philippines. According to Foxworthy: *

> Successful extraction of gutta from the leaves is done by the Dutch and the cultural methods adopted in the plantation are devoted exclusively to leaf production. * * *

No great development of the gutta-percha industry in the Philippine Islands can be expected until the trees are grown in plantations.

The most important use of gutta-percha is for the insulation of submarine and underground electrical cables. It is also utilized considerably in the manufacture of surgical appliances, funnels, bottles, and other articles which come in frequent contact with acids. For these purposes it is valuable on account of the ease with which it can be sterilized and its resistance to acids. A familiar form is as the outer covering of golf balls.

Palaquium ahernianum is a tree reaching a height of about 40 meters and a diameter of 1.5 meters. The leaves are alternate, pointed at both ends, wider toward the tip than near the base, from 12 to 20 centimeters long, the lower surface velvety and with a rusty color. The flowers occur singly or in groups of two or three on wart-like growths on the stem. The fruits are one-seeded, somewhat rounded, and about 2.5 centimeters in diameter.

This species is apparently confined to Mindanao.

Genus PAYENA

PAYENA LEERII Kurz. (Fig. 29).

GUTTA-PERCHA

According to Heyne † this tree produces a very good grade of gutta-percha.

This species has been collected once in Mindanao and once in Tawi-Tawi.

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* Foxworthy, F. W., Minor forest products and jungle produce. Government of British North Borneo, Department of Forestry Bulletin No. 1, Part II (1916), page 45.

† Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 4 (1917), page 12.

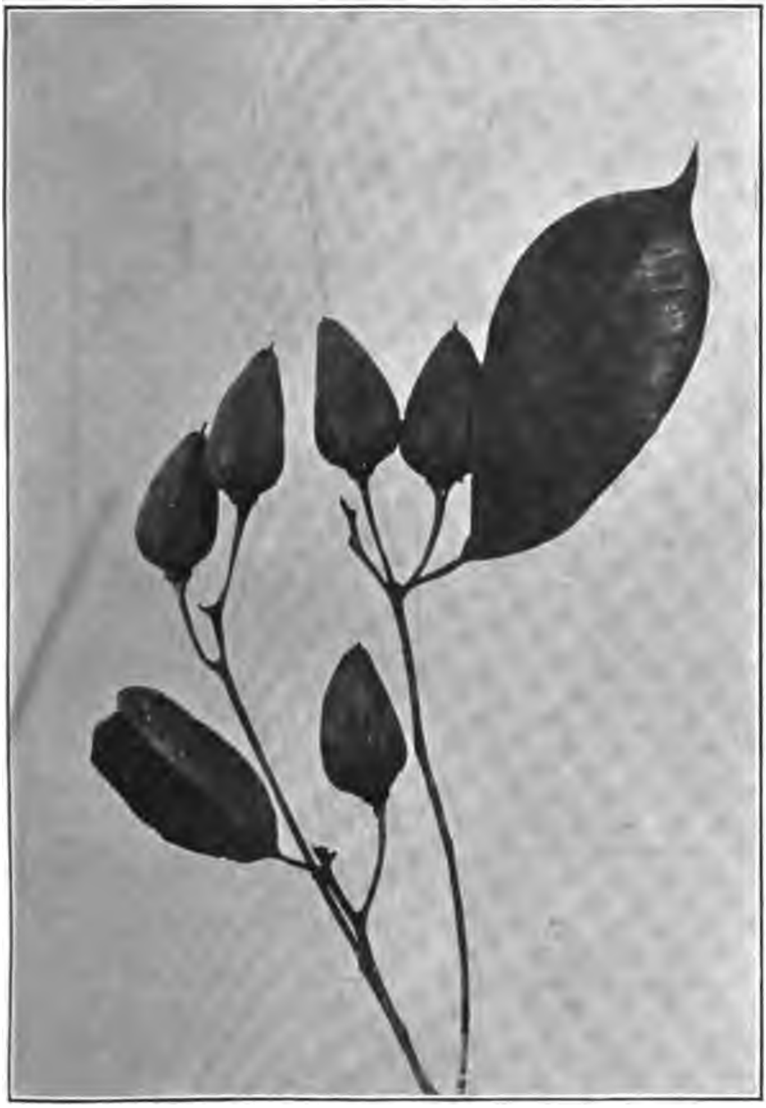

FIGURE 29. LEAVES AND FRUIT OF PAYENA LEERII, A SOURCE OF GUTTA-PERCHA.

Family APOCYNACEAE

Genus CHONEMORPHA

CHONEMORPHA ELASTICA Merr. (Figs. 30, 31). LISID.

Local names: *Goma, lisid* (Apayao).

RUBBER

In the Philippines there are a number of species of native plants which furnish rubber, but the only one known to yield rubber of a high grade is *Chonemorpha elastica.* Concerning the collection and quality of rubber from this plant, Sherman writes:*

> The Philippine rubber collectors are Samal and Joloano Moros living in Tawi-Tawi and the adjacent coral islands. The method of coagulation used by them was undoubtedly learned from the Moros of North Borneo, who with the Dyaks collect much of the rubber in that island. It consists in first pulling the vine down to the ground so as to be better able to tap it along its entire length. The milk is caught in cocoanut shells or leaves, and coagulated by pouring into sea water. The coagulation is almost instantaneous, and when properly manipulated a large amount of water can be mechanically inclosed inside the large balls along with plenty of chopped-up bark. The resulting rubber, of which I secured many samples, is white, tough, and very elastic so long as it is kept in sea water. On exposure to the air it blackens and decomposition slowly sets in.
>
> The chemical analysis of a sample of this rubber, after much of the dirt and water had been removed, resulted as follows:

	Per cent.
Dirt	3.76
Rubber	81.57
Resins	3.16
Water	11.51

Formerly this species existed in considerable numbers in Basilan and Tawi-Tawi, but the method of collection described above has naturally lessened the potential supply, and will reduce it to such an extent that it will not be profitable to gather the rubber. No extensive industry can be expected from the collection of rubber from this vine.

Chonemorpha elastica is a large, woody vine. The leaves are opposite, thin, rounded or slightly pointed at the base, pointed at the tip, 15 to 20 centimeters long, and 8 to 15 centimeters wide. The flowers are white, fragrant, and about 3 centimeters wide.

This species has been reported from Cagayan, Apayao, Benguet, Cavite, Mindanao, Basilan, and Tawi-Tawi.

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* Sherman, Jr., P. L. The gutta-percha and rubber of the Philippine Islands. Bureau of Government Laboratories Publication No. 7 (1903), page 39.

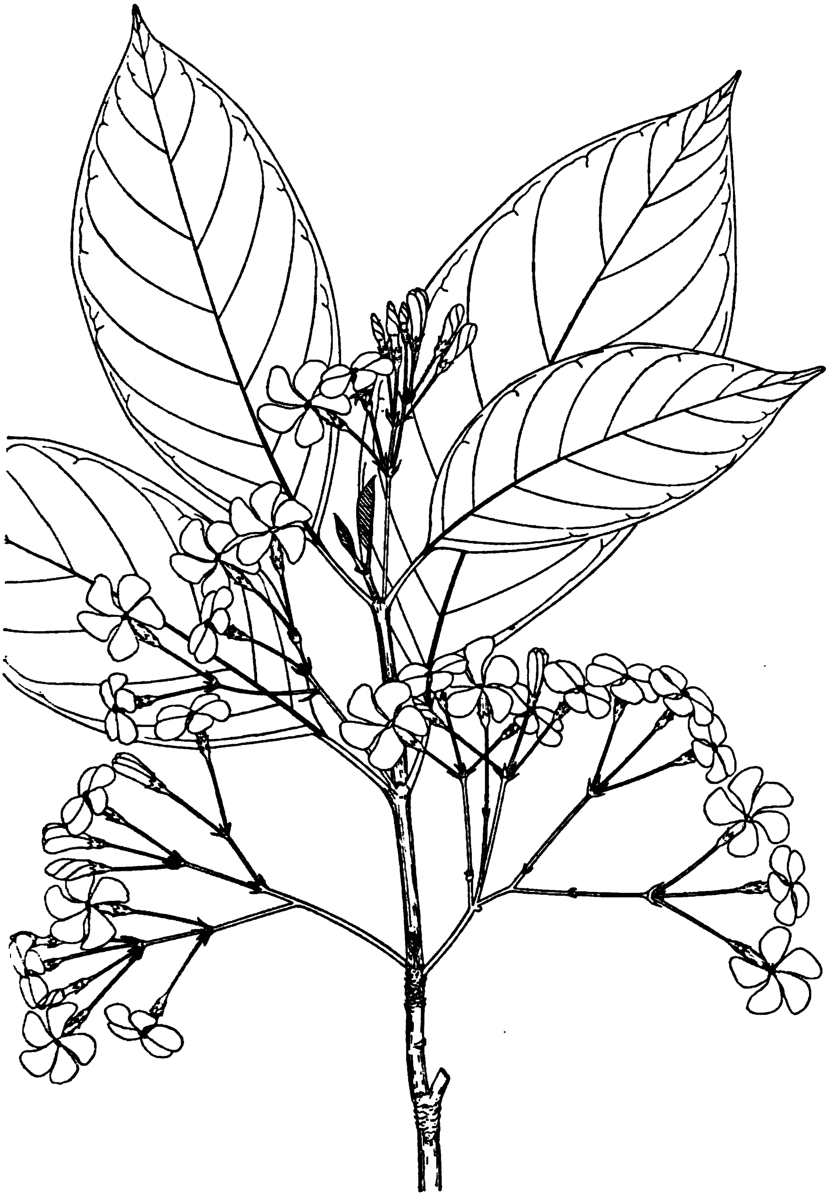

FIGURE 30. CHONEMORPHA ELASTICA (LISID), A RUBBER VINE. ×⅓.

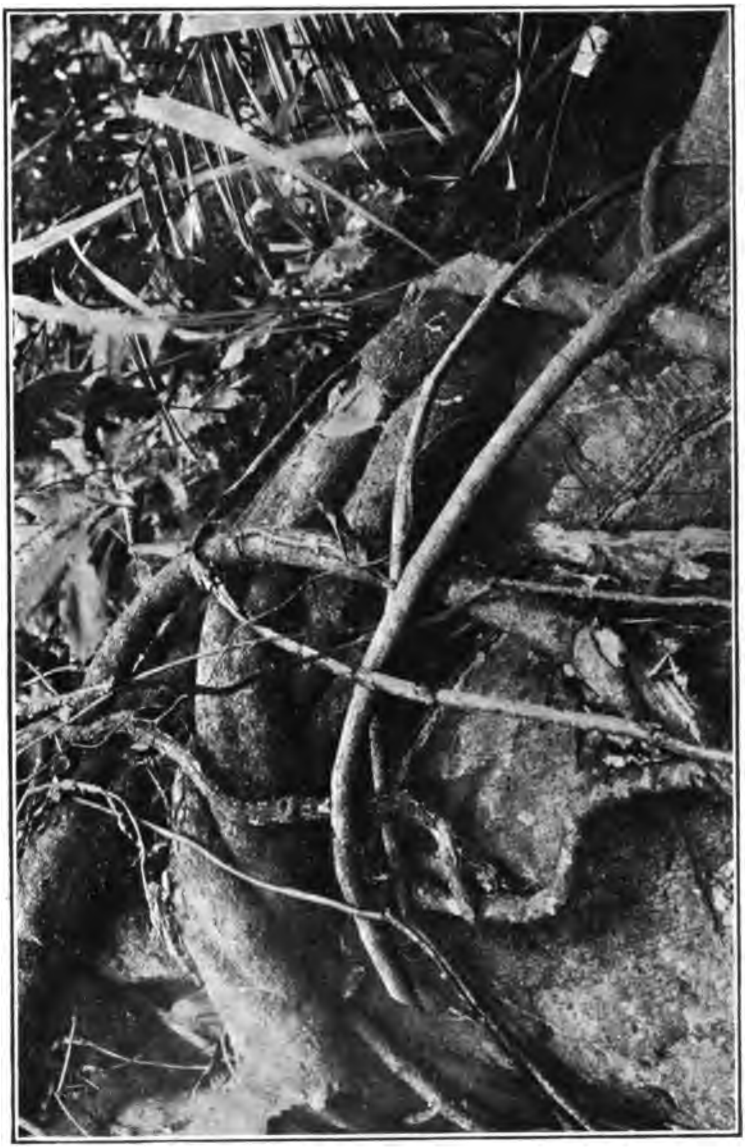

FIGURE 31. CHONEMORPHA ELASTICA (A RUBBER VINE) IN THE FOREST.

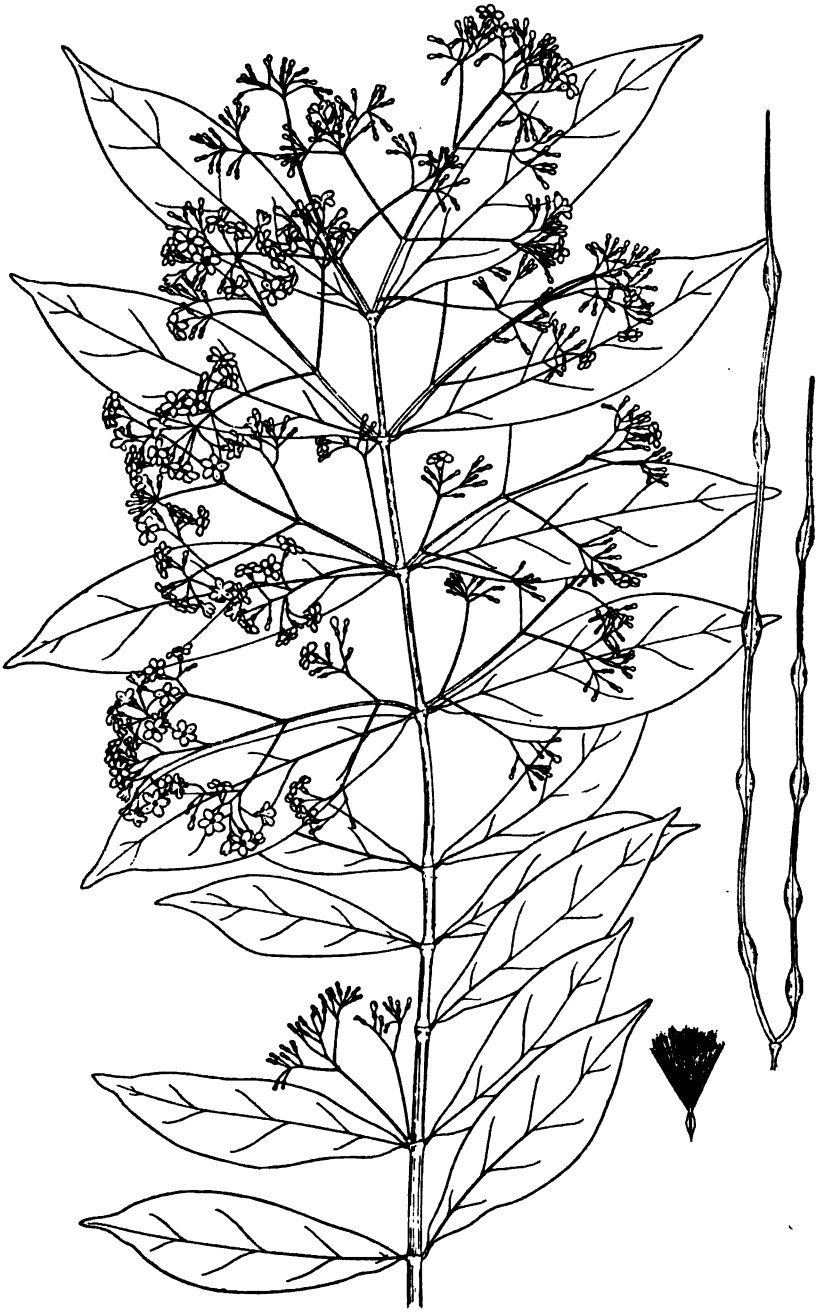

FIGURE 32. PARAMERIA PHILIPPINENSIS, (DUGTUNG-AHAS) A RUBBER VINE. ×½.

Genus PARAMERIA

PARAMERIA PHILIPPINENSIS Radlk. (Figs. 32, 33). DUGTUNG-ÁHAS.

Local names: *Dugtung-áhas* (Rizal); *ikdíng ñga púrau* (Igorot); *inggíu na putí* (Bataan); *karkarsáng* (Benguet); *kuni na putí* (Pampanga); *lupí-it* (Ilocos Sur); *parugtong-áhas* (Bulacan, Zambales, Rizal); *partaán* (Ilocos Sur); *pulang-pulang* (Zambales); *sada* (Benguet); *taguláuai* (Rizal).

RUBBER

This species yields rubber which is seemingly of rather poor grade. It has never been collected to any great extent. Locally the vine is apparently better known as a snake medicine than as a rubber plant.

The bark of this species is also used for making rope and for tying rice bundles.

Parameria philippinensis is a woody vine. The leaves are from 7 to 10 centimeters in length, somewhat oval in outline, and pointed at both ends. The flowers are fairly small, white, and occur in clusters. The fruits are very long and slender; the parts between the seeds are very narrow. The seeds are about a centimeter in length, sharply pointed at one end, and at the other end crowned with numerous white hairs about 2.5 centimeters long.

This species is common and is widely distributed in the Philippines.

Family BORRAGINACEAE

Genus CORDIA

CORDIA MYXA L. ANÓNANG.

ANÓNANG GUM

A description of this species and its local names are given in the bulletin on fibers.

Locally, a paste is prepared from the fruits.

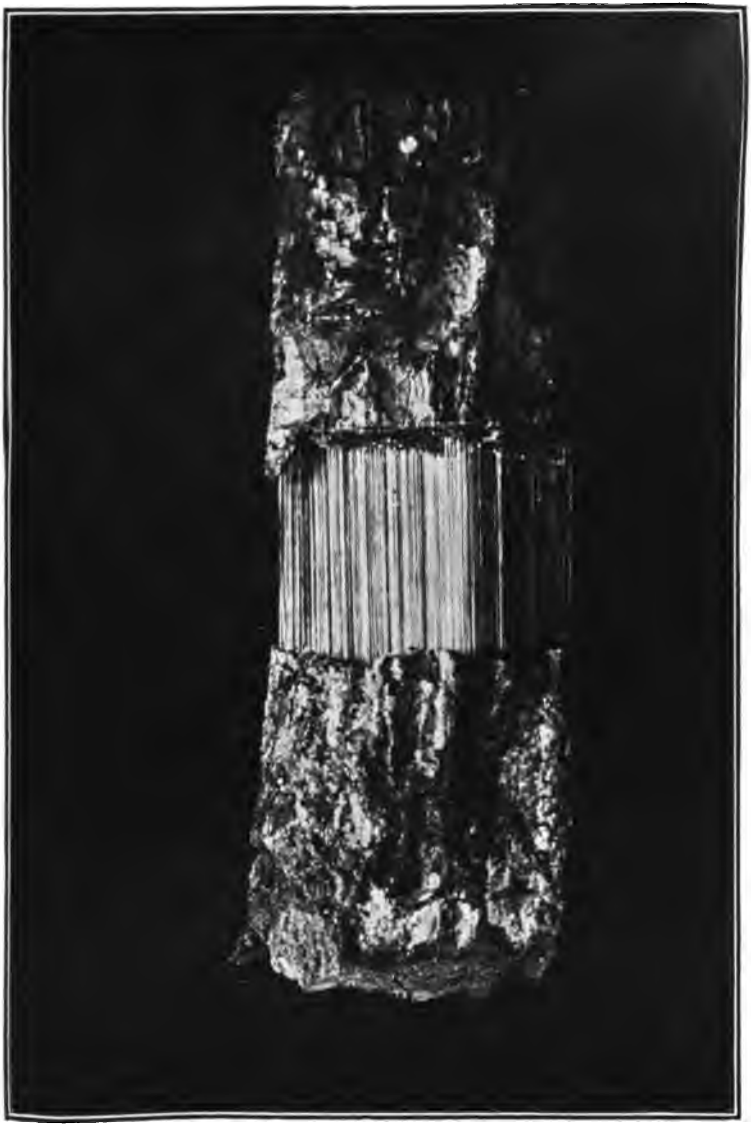

FIGURE 33. A PIECE OF DRY BARK FROM PARAMERIA PHILIPPINENSIS, BROKEN AND PULLED APART, SHOWING THE RUBBER.

SEED OILS

Vegetable oils are found naturally in the seeds of plants, and in many species the oil accumulates in considerable quantities. Many of these seed oils are edible, while others are useful for their medicinal properties or for the manufacture of paints, soaps, candles, or other practical purposes. In general, to obtain these oils, the seeds are first shelled. Although the oil may be obtained usually from the shelled seeds by extraction with organic solvents such as ether, the more general method is to subject the dried, shelled seeds to pressure. This process expels the oil, leaving a dried, crushed meal known as oil cake. The cake may be used for various purposes, depending upon its composition. If it does not contain injurious substances, it may be utilized for cattle food. Sometimes the oil cake is also employed as fertilizer or fuel. The expelled oil is filtered and, if necessary, subjected to further methods of refinement.

Edible oils usually contain both solid and liquid fats. Since fat is generally recognized as an indispensable constituent of human food, these edible oils are consequently substances of considerable importance. The fatty oils are sometimes called fixed oils, because when a drop of one of these oils is placed on wood it forms a rather permanent spot which does not evaporate readily on exposure to the air.

Fats (glycerides) consist essentially of glycerol (glycerin) combined with certain fatty acids such as oleic, palmitic, and stearic. The fats are usually insoluble in water, but dissolve readily in organic solvents. When boiled with an alkali solution they are decomposed (saponified) and converted into the alkali salts (soaps) of the fatty acids present, and glycerol. When fats, or edible oils containing fats, are exposed to light and air for a considerable length of time, they gradually decompose, forming free acids and other products, which have an unpleasant taste and odor. Oil which has been decomposed in this manner is said to be rancid. When decomposition has begun, the presence of micro-organisms appears to hasten these chemical changes. If the dried seeds are prepared properly and the oil obtained from them properly preserved, this decomposition can be hindered greatly and in some cases practically prevented. This is especially true of coconut oil, as Walker * has shown. Edible oils which are rancid and have a high acidity are not suited for edible purposes. Such oils are used largely for soap making. Since edible oils command a much higher price than soap oils, it is evident that when edible oils are allowed to become rancid the oil producer suffers considerable loss.

Investigation has shown that each particular oil has certain definite physical and chemical constants such as specific gravity, refractive index, saponification value, iodine value, etc. For a given oil, the exact value of these constants would naturally be affected by the purity of a particular sample and perhaps other factors. The results obtained by determining these various constants (oil analysis) are very useful in ascertaining the purity of a particular sample of a known oil or in endeavoring to identify an unknown one.

Lewkowitsch,† Allen,‡ Mitchell,§ Woodman,‖ and various other authorities give explicit directions for making oil analyses and explain how the results may be interpreted.

In recent years the demand for edible oils has been steadily increasing. As a result of this tendency, efforts have been made to convert oils formerly used for making soaps and candles into edible oils, which are considerably more valuable. For this purpose the method which has proved most successful is known as hydrogenation. This process consists in converting fatty oils, which are liquid at ordinary temperatures, into hard, solid fats. The liquid fats consist largely of olein, which is a combination of oleic acid and glycerol (oleic glyceride); solid fats consist largely of stearin, a combination of stearic acid and glycerol (stearic glyceride). The glycerides comprising the hard portion of an oil contain more hydrogen than those forming the soft portion. It is possible, then, to harden the soft portion by merely adding a small amount of hydrogen, which is a well-known chemical gas. The hydrogenation process has been used successfully for preparing oils suitable for the soap and candle industries and also for making edible oils. Not only are soft oils hardened by hydrogenation, but certain of their oil constants

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* Walker, H. S. The keeping qualities and the causes of rancidity in coconut oil. Philippine Journal of Science, Section A, Volume 1 (1906), page 117.

† Lewkowitsch, J. Oils, fats, and waxes. (1915), Volume 1.

‡ Allen, Commercial organic analysis. (1910), Volume 2.

§ Mitchell, C. A. Edible oils and fats, (1918).

‖ Woodman, A. G. Food analysis, (1915).

are changed considerably. This is especially true of the iodine value, which is decreased greatly, and of the specific gravity, which is increased.

The question of the edibility of hydrogenated oils has been discussed to some extent in chemical literature.*

> It seems to be generally accepted by those who have investigated the matter carefully that the hydrogenated oils have as desirable a degree of edibility as the oils from which they are derived. It is even claimed that by destroying traces of certain unsaturated bodies thought to be slightly toxic in nature, hydrogenation renders the oil better adapted for human consumption.

Concerning the hydrogenation of oils, Thompson † states:

> The combined capacity of the hydrogenating plants of Europe is estimated for 1914 at 250,000 tons (1,375,000 barrels), which is two or three times as much as has ever been treated. These plants are in England, Norway, Germany, and France, and are engaged at present chiefly on fats for soap and candles. They are hardening linseed, whale, soya-bean, and cottonseed oils.
>
> The great increase in the demand for margarin in Europe, for compound lard in the United States, and for hard soap all over the civilized world has resulted in closely crowding the supply of natural hard fats, while liquid oils are relatively abundant. A few years ago strictly edible liquid oils seemed to be growing scarcer, but the new scheme of deodorization began to relieve this shortage by lifting the so-called soap oils into the edible class. The same process was applied to copra and palm-kernel oils, and finally caused a scarcity of soap greases. Hydrogenation now promises a further readjustment of conditions by permitting the transfer at will of any oil from the liquid to the solid class, and it will bring into use some relatively rare oils, and encourage the production of still others.

In producing oils intended for edible purposes, it is obvious that the highest grade of purity is desirable, to obtain which, the raw materials, such as seeds or fruits, should be selected carefully, and worked up rapidly, in as fresh a condition as possible. Special care should be observed to avoid the presence of considerable quantities of free fatty acids, since these substances tend to decompose the oils and cause rancidity.

Seed oils which contain toxic substances are naturally unsuited for edible purposes. Such oils frequently have properties which make them especially valuable for various other purposes, such as the manufacture of medicinal preparations, paints, varnishes, etc. Certain seed oils, for instance, have unusual drying properties which make them useful as paint oils. Linseed oil, which has the property of absorbing oxygen from the air and forming a dry, hard coating, is the most important of the drying oils and is employed extensively in making paints and varnishes. Philippine lumbang oil is also an excellent drying oil.

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* Ellis, C. The hydrogenation of oils (1919), page 323.

† Thompson, E. W. Cottonseed products and their competitors in northern Europe. Department of Commerce, Special Agents Series No. 89. Part II, Edible oils, 1914, page 26.

Andés * gives the composition of numerous oil cakes and discusses the practical application of these materials as cattle foods or fertilizers.

FAMILY PALMAE

Genus COCOS

COCOS NUCIFERA L. (Figs. 34–37). COCONUT PALM.

COCONUT OIL

Coconut oil, which is derived from the fleshy kernels of *Cocos nucifera,* is far more important in the commerce of the Philippines than all other oils combined. An adequate discussion of an agricultural subject such as this would require so much space as to be out of place in a publication dealing primarily with forest products. As explained in the preface, there are very few important oils derived from cultivated plants in the Philippines, and so it has seemed advisable to include a short account of these in the present bulletin.

High-grade coconut oil is edible and is employed largely in making edible fats and artificial butter (margarine or oleomargarine). The lower and cheaper grades, which usually contain a considerable proportion of free fatty acids, are not suitable for food and are used principally for making soaps and candles. Coconut oil is also used in cooking, as an illuminant, and for various other purposes, such as the preparation of lotions, salves, and hair cosmetics. The uses of the different products of the coconut palm have been discussed by Miller † and by Brown and Merrill.‡

The usual method of obtaining coconut oil is essentially as follows: The husks are first removed from the nuts, after which they are split by a large knife and the milk poured off. The split nuts are next dried in the sun, or by artificial heat, after which the dried meat or copra is easily removed from the shells. The copra is then ground in a mill, heated, and subjected to pressure. The oil cake which remains after the first expression still contains a considerable quantity of oil. In some mills this cake is subjected to a second expression by means of hydraulic presses after which it contains only a slight percentage of oil. The coconut oil obtained is filtered and stored in large tanks, ready for domestic use or export. The oil cake, which remains after the oil has been expressed, is used as cattle food or, sometimes, as fertilizer or fuel.

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* Andés, L. E., and Stocks, H. B., Vegetable fats and oils, (1917), page 323.

† Miller, H. H., Commercial geography, the materials of commerce for the Philippines, (1911).

‡ Brown, Wm. H., and Merrill, E. D., Philippine palms and palm products. Bureau of Forestry Bulletin No. 18 (1919).

In recent years the demand and prices for animal fats, such as lard and butter, have been steadily growing and it seems that there will probably be a permanent shortage of animal fats. This has led to a greatly increased use of vegetable fats by European and American makers of artificial butter, resulting in an unusual demand for these vegetable products. Coconut oil, which was formerly utilized largely in making soaps and candles, is the most popular ingredient of artificial butter.

> * * * Marseilles, which is the most important soap-manufacturing city in Europe, requires annually something like 120,000 tons of fat for this industry. Heretofore 40 per cent of this has been coconut oil. But in recent years, out of the total production of 85,000 tons of copra oil in Marseilles, about 50,000 tons are sold direct as an edible fat, and 10,000 tons are exported to the Netherlands and elsewhere for mixing with cottonseed oil, peanut oil, and other soft fats to make oleomargarin; this leaves but 25,000 tons for the soap trade there, when the normal supply from this source has been 48,000 tons.[*]

As a result of the increased demand for coconut oil, new coconut plantations are being developed, and it is said that some of the margarine manufacturers have acquired plantations and oil mills, so that they may control their own raw product. These trade conditions in vegetable fats have naturally affected the Philippines, which is one of the largest coconut-producing countries in the world.

Formerly, a large proportion of Philippine coconuts were converted into copra, which was shipped to the United States and European countries where the oil was expressed. When copra is allowed to stand for a considerable length of time before shipment it tends to deteriorate, causing a loss in the quality and quantity of the oil. Obviously, in so far as this deterioration is concerned, it is more economical to produce the oil in the countries where the coconuts are grown. This would logically reduce the bulk of the shipments and avoid possible losses due to spoiling. The recent shortage of shipping space naturally

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[*] Brill, H. C. and Agcaoili, F., Philippine oil-bearing seeds and their properties: II. Philippine Journal of Science, Section A, Volume 10 (1915), page 106.

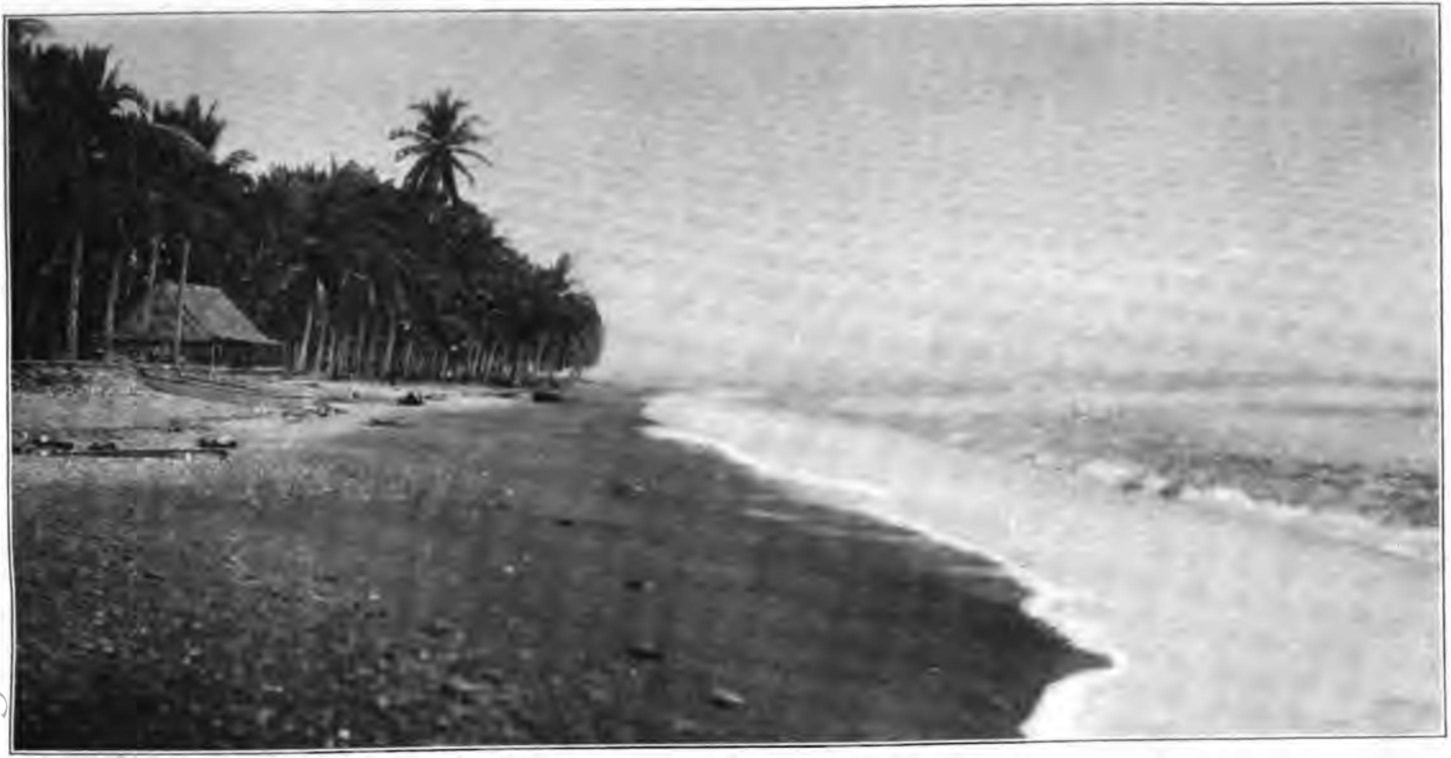

FIGURE 34. COCONUT PALMS GROWING ON THE BEACH AT SAN RAMON, MINDANAO.

made it even more advisable to express the oil near the source of coconut production. The result of these various conditions has been the establishment of a considerable number of oil mills in the Philippines. The increase in the coconut-oil business in the Philippines is shown very clearly in Table 8, which gives the exports of copra and coconut oil for the years 1913 to 1918.

TABLE 8.—*Amount and value of copra and coconut oil exported from the Philippines from 1913 to 1918.*

Year.	Copra.		Coconut oil.	
	Amount.	Value.	Amount.	Value.
	Kilograms.	*Pesos.*	*Kilograms.*	*Pesos.*
1913	82,219,368	19,091,448	5,010,429	2,292,678
1914	87,344,695	15,960,540	11,943,829	5,238,866
1915	139,092,902	22,223,109	18,464,169	5,641,008
1916	72,277,164	14,231,941	16,091,169	7,851,469
1917	92,180,326	16,654,301	45,198,415	22,818,294
1918	55,061,736	10,377,029	115,280,847	63,328,317

In order to produce high-grade coconut oil, suitable for edible purposes, only ripe nuts should be used, and the copra should be dried properly. These two important points can hardly be overemphasized.

Ripe coconuts give a much greater yield of copra and coconut oil than green nuts. Coconuts are sometimes, carelessly or intentionally, cut from the tree before they are fully ripe, causing considerable financial loss. Concerning the use of green nuts, Walker,† who has made extensive investigations on copra and coconut oil, states:

> * * * The percentage of anhydrous copra in the meat of the green fruit is 33.7; it rises to 50.1 in that of the "fairly ripe" nuts and increases to 53.3 in those marked "dead ripe." * * * Only thoroughly ripe nuts (the husks of which have begun to turn brown) should be used, and it is often advisable to allow the latter to stand in a dry place for a few weeks before they are opened. * * *

Walker also says that there appears to be a slight increase in the proportion of meat, copra, and oil in nuts which have been stored, up to a maximum of three months after cutting;

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† Walker, H. S., The coconut and its relation to the production of coconut oil. Philippine Journal of Science, Volume 1 (1906), page 71.

Walker, H. S., The keeping qualities and causes of rancidity in coconut oil. Philippine Journal of Science, Volume 1 (1906), page 140.

Walker, H. S., Notes on the sprouting coconut, on copra, and on coconut oil. Philippine Journal of Science, Section A, Volume 3 (1908), page 126.

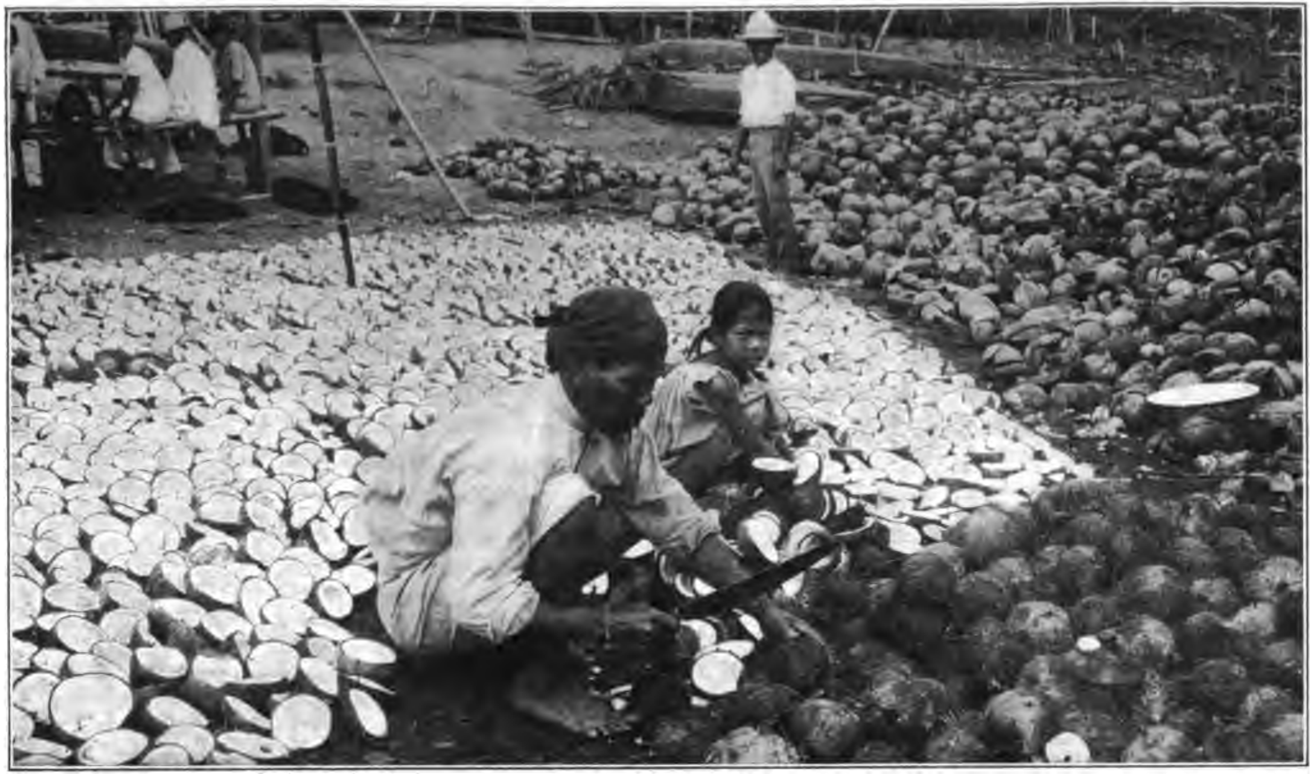

FIGURE 35. OPENING COCONUTS FOR DRYING AT PAGSANJAN, LAGUNA.

and that beyond this period, which coincides with the time that the sprout makes its appearance, there is a decided decrease in the above constituents.

The quality and value of coconut oil depend largely upon the condition of the copra at the time of milling. Copra which has not been sufficiently dried becomes moldy. The molds tend to decompose, or hydrolyze the fats in the copra, with the result that the oil, after expression, contains free, fatty acids, becomes rancid quickly, and acquires a bad odor. Walker made a large number of experiments to determine the conditions which induce this deterioration and the methods by which it could be prevented. He found that, ordinarily, commercial copra contained from 9 to 12 per cent of moisture and that this amount was very favorable for the growth of molds. Most of the free acids and the accompanying bad odor and taste which are present in coconut oil are produced in the copra itself. Walker found that no organisms grew, and that there was no change of acidity, in a sample of copra containing 4.7 per cent of moisture. The remedy is to dry the copra until it contains no more than 5 per cent of moisture, which prevents the growth of mold; and to express the oil as soon as possible, thereby avoiding long storage in a warm, moist atmosphere. He says that the copra should be fresh and be prepared under the best possible conditions of drying, and that the oil should be thoroughly dried and filtered until absolutely clear. Under these conditions it should be capable of shipment or storage without noticeable deterioration. He believed, contrary to many statements, that the keeping qualities of coconut oil prepared in a pure state were superior to those of most other vegetable fats and oils. When sufficient sugars and albuminoids are left in the oil, if, in other words, it is not properly filtered, molds which have been pressed out with the oil or, in the case of hot-pressed oil, which enter the freshly prepared oil, cause a rapid splitting of the fat and an increase in acidity.

Brill, Parker, and Yates * confirmed Walker's conclusions, that the deterioration of copra is due largely to molds and not to bacteria, since a moisture content sufficiently high to favor bacterial growth is not found ordinarily in copra and, moreover, bacteria cause scarcely any loss even under conditions most favorable for their growth. These writers found four molds occurring upon coconut meat and moldy copra. The spore masses of the four molds differ considerably in color and are

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* Brill, H. C., Parker, H. O., and Yates, H. S., Copra and coconut oil. Philippine Journal of Science, Section A, Volume 12 (1917), page 55.

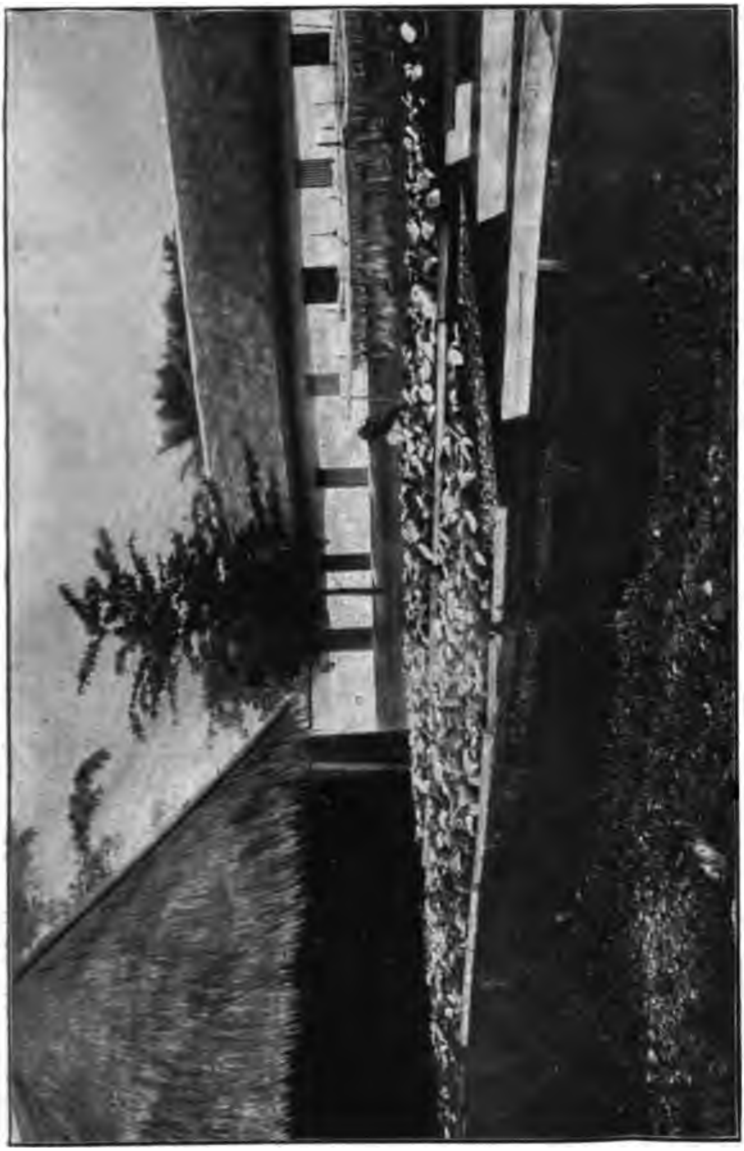

FIGURE 36. SUN-DRYING COCONUTS, SHOWING THE NUTS ON THE TRAYS READY TO BE PUSHED UNDER THE SHELTER.

easily distinguished without the aid of a microscope. These molds are given below in the order of their moisture requirements; the first one needing the most moisture for growth and the last one the least.

White mold, *Rhizopus* sp. This mold occurs only on fresh meat in a practically saturated atmosphere. It forms loose masses of white threads, with many black sporangia.

Black mold, *Aspergillus niger,* Van Teigh. A mold which occurs in copra with a relatively high moisture content and produces black spore bodies, giving the mold a black color.

Brown or yellow mold, *Aspergillus flavus,* Link. This species is the most common one on moldy copra. The spore masses, which are at first greenish yellow, gradually become brown.

Green mold, *Penicillium glaucum* Link. This mold produces green spores, and occurs commonly on copra, especially if it contains a low percentage of moisture. It causes very little loss of oil.

Experiments showed that the brown mold, which occurs on copra having a small moisture content, under ordinary conditions caused much more damage than the others. Under conditions favorable for its growth, this mold caused in one month a loss of 30 to 40 per cent of the total oil. The oil also contained a considerable amount of free fatty acids and was of poor quality.

According to Brill, Parker, and Yates, copra which has been dried to a moisture content of about 6 per cent does not absorb water and become moldy unless stored in a saturated atmosphere for prolonged periods of time.

The Bureau of Science in Manila frequently receives for analysis samples from the various coconut-oil mills in the Philippines. Reports on these analyses made during the latter part of the year 1919 have been compiled by the Division of Organic Chemistry. Their results show that Philippine coconut oil has the following average specific gravity (degrees centigrade) $\frac{30^\circ}{4^\circ} =$ 0.91461. The fatty acids, calculated as oleic acid, usually average 4 to 5 per cent. The results of a large number of analyses of copra and copra cake are given in Table 9. These figures, based upon general factory conditions throughout the whole archipelago, represent percentages as nearly correct as can be obtained.

The figures given in Table 9 are based upon fresh hydraulic and expeller cake, and not on cake stored for several months. The latter would show an exceedingly high, free fatty acid con-

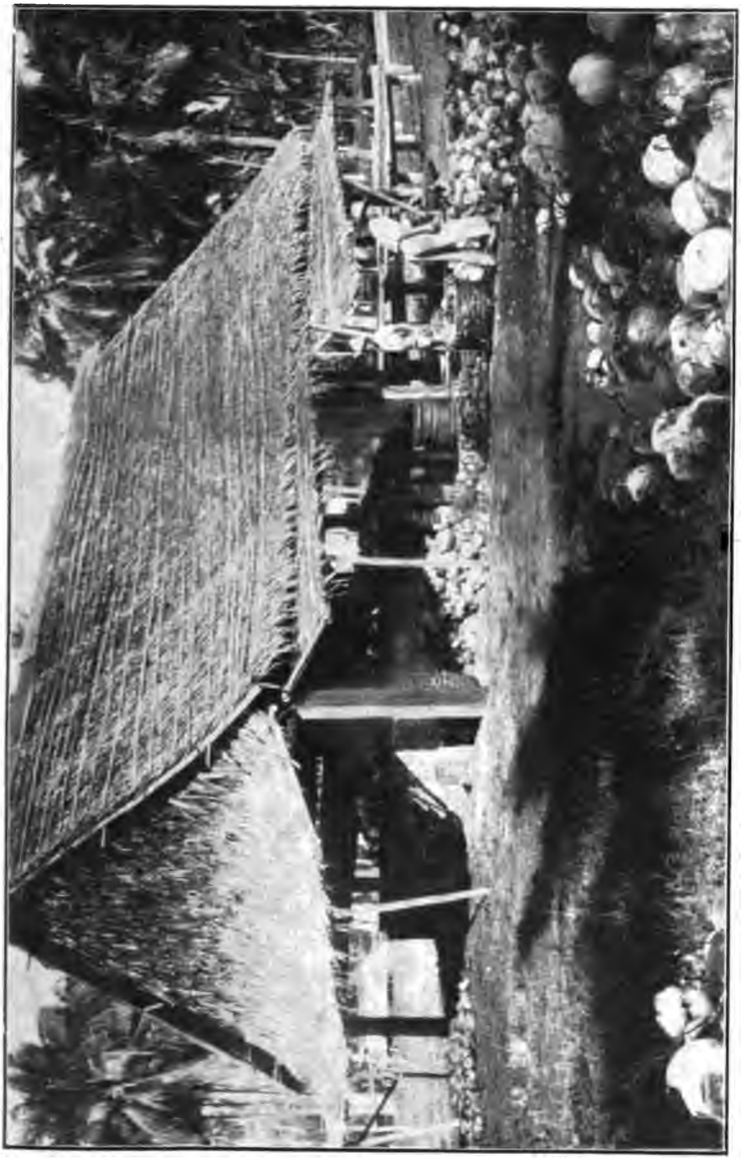

FIGURE 37. KILN USED FOR DRYING COCONUTS.

tent. In compiling these results, unusual analyses representing small quantities of either exceedingly good or poor copra have not been included. These exceptional samples have shown a percentage of oil as high as 71, or as low as 57.5.

TABLE 9.—*Analysis of copra and copra cake.*

[Compiled by Division of Organic Chemistry, Bureau of Science.]

Constants.	Copra.			Copra cake.					
	Percentage.			Percentage.					
	Maximum.	Minimum.	Average.	Maximum.		Minimum.		Average.	
				Expeller.	*Hydraulic.*	*Expeller.*	*Hydraulic.*	*Expeller.*	*Hydraulic.*
Oil	67.4	62	65.5	15.5	6.0	10.5	4.0	12.5	5.0
Ash	--------	--------	--------	5.97		5.78		5.90	
Crude fiber	--------	--------	--------	10.92		7.85		9.5	
Protein	--------	--------	--------	21.44		16.8		19.9	
Moisture	7.0	4.5	5.5	9.2		4.0		5.88	
Free fatty acids calculated as oleic acid	6.2	3.0	4.8	12.0		4.0		7.2	

Coconut oil in temperate climates, at ordinary temperatures, is a solid fat, but in tropical countries it is usually a thick liquid. The high-grade oil is nearly colorless, has a bland taste, and the peculiar odor of coconuts. It consists largely of the glycerol esters of lauric and myristic acids and contains also a number of other fats which are the glycerol esters of still other fatty acids, such as caproic, caprylic, capric, and oleic. The exact composition of coconut oil is somewhat uncertain.

The physical and chemical constants of the oil obtained from different localities are given by various authorities as follows:

Specific gravity	15.5°	0.9259
	18°	0.9250
Solidifying point		15.7–23
Melting point		23–25
Saponification value		255–260
Iodine value		8–9.5
Reichert value		3.5–3.7
Reichert-Meissl value		6.7–7.5
Hehner value		88.6–90.5
Polenske value		16.8
Refractive index, 60°		1.441
Butyro refractometer 15.5°		49.1
Viscosity (seconds at 140°F.)		63.9–64.7

Genus ELAEIS

ELAEIS GUINEENSIS Jacq. OIL PALM.

PALM OIL

This species yields two kinds of oil, known as palm oil and palm-kernel oil. Palm oil is obtained from the fleshy part of the fruit while the palm-kernel oil is expressed from the kernels. The uses of palm-kernel oil, for edible and technical purposes, are increasing considerably and the consumption of palm oil is also increasing.

Palm oil is used chiefly for the manufacture of soaps and candles. It consists principally of palmitin and olein. Nordlinger * says that 98 per cent of the solid, fatty acids of palm oil is palmitic acid. The fresh oil has an agreeable odor, a bright orange color, and a consistency somewhat like that of butter. It is used as an edible fat by the natives of Africa.

Palm-kernel oil has a white or slightly yellow color. It has a composition which is quite different from palm oil and resembles coconut oil in its general composition, but contains a somewhat lower proportion of the glycerides of the lower fatty acids. The better grades are used for making vegetable butter, and the lower grades for soap manufacture.

The oil palm occurs naturally in immense numbers along the west coast of Africa. According to Hubert † the annual exports of oil and kernels from tropical Africa exceed in value forty million dollars. The oil palm grows well in the Philippine Islands and apparently produces fruit abundantly. It is not known to be attacked by any insects, fungi, or bacteria. Large plantations of oil palms are now being started in Sumatra and the Malay Peninsula. The cultivation of this plant in some parts of the Philippines would probably be advisable.

Family HERNANDIACEAE

Genus HERNANDIA

HERNANDIA OVIGERA (*peltata*) L. KORON-KÓRON.

Local names: *Koron-kóron* (Camarines); *pantog-lóbo* (Tayabas).

HERNANDIA OVIGERA OIL

According to Heyne,‡ a fat used in lamps and for making candles is obtained from the fruits.

Hernandia ovigera is a small to medium-sized tree. The leaves are alternate, pointed at the tip, and frequently have the petiole attached within the margin. The flowers are whitish and about 1 centimeter wide.

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* Nordlinger, Zeitschrift für angewandte Chemie, 1892, page 111.

† Hubert, P., Le palmier á huile.

‡ Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 2 (1916), page 177.

This species is distributed from Luzon to Mindanao, but is apparently not common.

Family MORINGACEAE

Genus MORINGA

MORINGA OLEIFERA Lam. MALUNGGÁI or HORSE-RADISH TREE.

Local names: *Arunggái* (Pangasinan); *balunggái* (Cuyo Islands); *kalamunggái* (Misamis); *kalunggái* (Camarines); *kamalunggái* (Mindoro); *kamalunggi* (Pampanga); *malugái* (Culion Island); *malunggái* (Tarlac, Bulacan, Zambales, Bataan, Rizal, Laguna, Manila, Batangas, Tayabas, Mindoro, Capiz, Zamboanga); *marunggái* (Ilocos Norte and Sur, Abra); *maronggói* (Zambales).

BEN OIL

The root of this species has a taste somewhat like that of horse-radish and in India is eaten by Europeans as a substitute for it. The wood, when fresh, has a like taste and odor. This species yields seeds from which ben oil is obtained.

The oil is said to be used for salads and culinary purposes, and to equal the best Florence oil as an illuminant.

According to the bulletin of the Imperial Institute:*

> The oil is particularly valuable for ointments since it can be kept for almost any length of time without undergoing oxidation. This property, together with the absence of colour, smell and taste, renders it peculiarly adapted for use in the "enfleurage" process of extracting perfumes.

The seeds of *Moringa oleifera* consist of about 8 per cent of husks and 92 per cent of kernels. The shelled kernels yield about 36 per cent of ben oil, which is obtained by expression. Table 10 shows the constants of cold- and hot-pressed oil obtained from Nigerian ben seeds.† Analyses of the oil cake which is left after expelling the oil from the ben seeds are given in Table 11.

TABLE 10.—*Constants of ben oil.*

Constants.	Crude cold-pressed oil from northern Nigeria.	Crude hot-pressed oil from northern Nigeria.
Specific gravity	0.9018	0.8984
Acid value	49.71	100.50
Saponification value	179.20	178.70
Unsaponifiable matter	1.67	2.69
Iodine value	100.30	88.00

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* Bulletin of the Imperial Institute. Volume 2 (1904), page 118.

† Bulletin of the Imperial Institute. Volume 6, 1908, page 359.

TABLE 11.—*Analysis of oil cake from ben seeds.*

Constituents.	Hot-pressed cake, northern Nigeria.	Cake from Jamaica seed.
	Per cent.	*Per cent.*
Moisture	5.96	7.15
Albuminoids	24.12	21.51
Other nitrogenous substances	34.81	24.56
Fat	11.27	11.27
Fibre	4.82	
Ash	5.66	4.98
Other non-nitrogenous substances	13.86	

Ben oil consists largely of the glycerides of oleic, palmitic, and stearic acids. It also contains a solid acid of high melting point.

Moringa oleifera is a small tree 8 meters or less in height, with very soft, white wood and corky bark. The leaves are alternate, 25 to 50 centimeters long, and usually thrice pinnate. There are three to nine leaflets on the ultimate pinnules. The leaflets are 1 to 2 centimeters long. The pod is 15 to 30 centimeters long, pendulous, three-angled, and nine-ribbed. The seeds are three-angled and winged on the angles.

This species is widely distributed in the Philippines and in the tropics generally. It grows rapidly even in poor soil and is but little affected by drought.

Family PITTOSPORACEAE

Genus PITTOSPORUM

PITTOSPORUM PENTANDRUM (Blanco) Merr. MAMÁLIS.

Local names: *Balingkauáyan* (Antique); *basuít* (Abra); *bolongkoyan, saboágon* (Guimaras Island); *darayau* (Palawan); *díli* (Nueva Vizcaya); *lasuít, pasguik* (Benguet); *mamales* (Benguet, Rizal); *mamális* (Pangasinan, Bataan, Nueva Ecija, Bulacan, Rizal, Laguna); *oplái* (Iloko); *pañg-anto-an* (Cebu); *taliu* (Zambales).

MAMÁLIS OIL

Concerning the oil from this species, Bacon * writes:

> * * * The fruits are quite small, and there is considerable labor involved in gathering them. One tree yielded 16 kilos of fruit which after grinding gave 210 cubic centimeters of an oil of pleasant odor by distillation with steam. The crude oil boiled from 153° to 165° and after being washed with alkalies and distilled over sodium, had the following properties:

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* Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), page 118.

Boiling point, 155° to 160° (principally 157° to 160°); specific gravity, $30^\circ = 0.8274$; $N_D^{30^\circ} = 1.4620$; $A_D^{30^\circ} = 40.40$.

These properties leave little doubt but that this oil consists principally of the same dihydroterpene that is found in the higher boiling portions of the oil of the ordinary petroleum nut.

Pittosporum pentandrum is a tree reaching a height of 20 meters and a diameter of about 50 centimeters. It is, however, usually much smaller than this. The leaves are alternate, pointed at both ends, about 10 centimeters long and less than 2 centimeters in width. The flowers are small, white, fragrant, and are crowded on small flowering branches. The fruits are about a centimeter long and contain a number of seeds.

This species is common and widely distributed in the Philippines from Luzon to Mindanao, especially in thickets and second-growth forests. Experiments have shown that it grows vigorously in cultivation.

PITTOSPORUM RESINIFERUM Hemsl. (Fig. 38). PETROLEUM NUT.

Local names: *Abkol, abkel, lañgis* (Benguet); *dingo* (Mountain Province); *sagága* (Àbra).

PETROLEUM-NUT OIL

The fruits of this species are known in the Philippines as petroleum nuts because of the fancied resemblance of the odor of the oil to that of petroleum and because even the green fresh fruits will burn brilliantly when a match is applied to them.

The chemical properties of the oil have been investigated by Bacon.* He found that the oil from the petroleum nut was very interesting, as it contained a dihydroterpene, $C_{10}H_{18}$, and also considerable quantities of normal heptane, which had only once before been found in nature, occurring in the digger pine (*Pinus sabiniana* Dougl.) of California.

In working up the various lots of *Pittosporum* fruits, considerable differences were noted in the proportion of heptane and dihydroterpene found in the oil, and the season and degree of ripeness of the fruits undoubtedly play a considerable rôle in this respect.

The first lot of nuts was obtained from Baguio, Benguet, in the autumn of 1907. One kilo of whole, fresh nuts gave 52 grams of oil on a press. The residue ground up and again pressed yielded an additional 16 grams of oil; specific gravity=0.883; $N_D^{30^\circ} = 1.4577$. It was not possible to determine the optical rotation. The oil is quite sticky, and in a thin layer rapidly becomes resinous. In an open dish it burns strongly, with a sooty flame. It distills unchanged up to 165°, then with decomposition to give

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* Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), page 115.

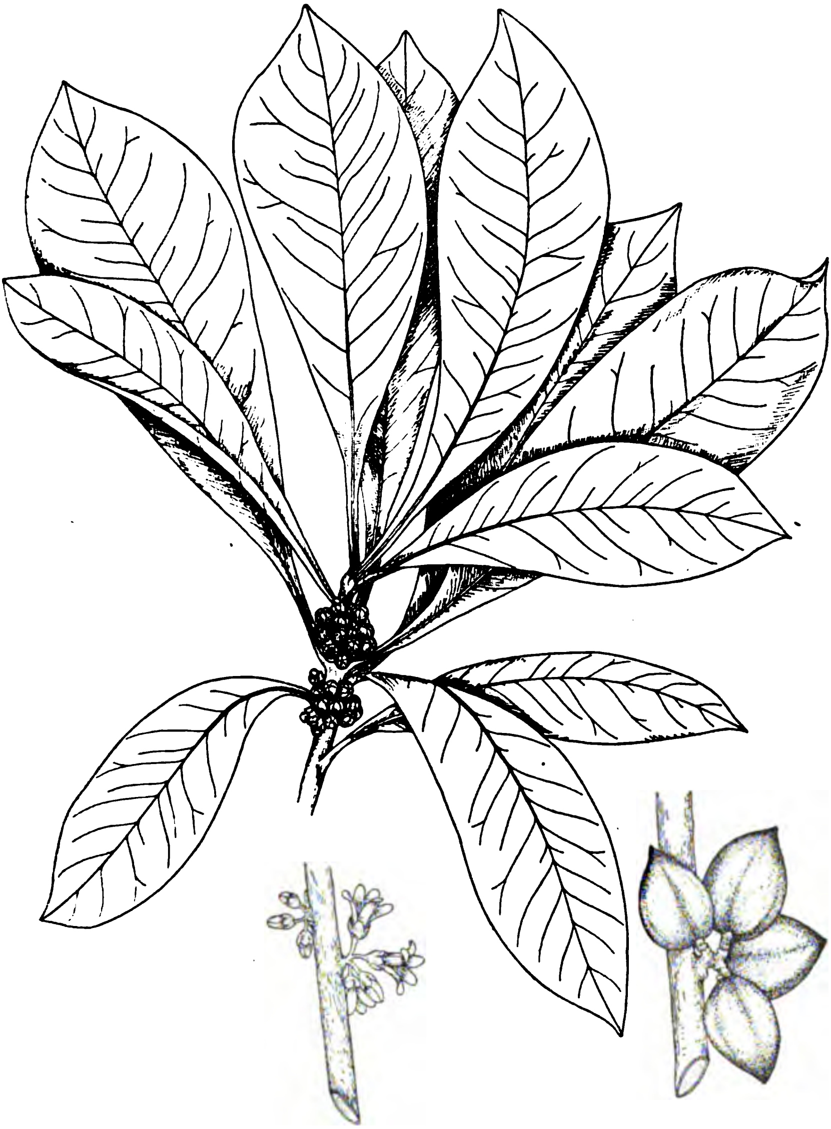

FIGURE 38. PITTOSPORUM RESINIFERUM (PETROLEUM NUT), THE SOURCE OF OIL OF PETROLEUM NUTS. ×⅓.

a resin oil. The oil distilling from 100° to 165° is colorless, with an orange-like odor; specific gravity, $\frac{30^\circ}{4^\circ}=0.7692$; $A\frac{30^\circ}{D}=+37^\circ.0$. By two careful distillations the following fractions were obtained:

	Fraction (degrees.)	Grams.
(1)	98–103	41
(2)	103–110	18
(3)	110–120	21
(4)	120–140	12
(5)	140–150	7
(6)	150–155	47
(7)	155–160	49

Fraction No. 1 had a pleasant odor recalling oranges, and the following properties: specific gravity, $\frac{25^\circ}{4^\circ}=0.6831$; $N\frac{D}{30^\circ}=1.3898$; optical rotation=0.

Fraction No. 7 had a turpentine-like odor. Specific gravity, $\frac{30^\circ}{4^\circ}=0.8263$, $N\frac{30^\circ}{D}=1.4630$.

The properties of fraction No. 1 leave little doubt of the identity of this compound with normal heptane.

A second lot of petroleum nuts was obtained in December, 1908, from one of the upper ridges of Mount Mariveles, Bataan Province. One tree gave 15 kilos of fruits, which by pressure yielded 800 cubic centimeters of oil. The residue ground up and distilled with steam yielded 73 cubic centimeters more. This oil distilled in steam contained no heptane, showing that probably all the latter is in the oil cavities immediately surrounding the seeds, and that the pulp of the fruit contains only resins and the higher boiling portions of the oil. It was also noted that the leaves, branches, bark, wood, and in fact, all parts of the tree are distinctly resiniferous and have the same pleasant, orange-like odor as the fruits. * * *

Pittosporum resiniferum is a tree reaching a height of 25 to 30 meters, although in many cases it fruits when not over 6 to 12 meters high. It has fragrant, white flowers, about 1.3 centimeters long, which are borne in clusters on the stem. The leaves are smooth, pointed at both ends, and usually between 8 and 15 centimeters in length. The fruits are about 3 centimeters long.

This species is not very abundant in any part of the Islands, but is widely distributed and usually found on high mountain ridges.

Family LEGUMINOSAE

Genus ARACHIS

ARACHIS HYPOGAEA L. MANÍ OR PEANUT.

PEANUT OIL

This plant is rather extensively grown in the Philippines and yields the edible nuts known as peanuts or ground nuts, from which arachis oil (peanut or ground-nut oil) is obtained by expression. High-grade arachis oil is nearly colorless and has a pleasant taste. It is edible and is used as a salad oil, especially as a cheaper substitute for olive oil. The lower grades are used for making soaps or for burning.

Very little peanut oil is produced in the Philippine Islands, but its manufacture on a large scale is well worth consideration, as in certain other countries it is an article of considerable commercial importance.

According to Thorpe,* the total quantity of arachis nuts produced in the world is approximately 350,000 tons per year. Large quantities of these nuts are used in France, Austria, Germany, and the United States. Although about 50,000 tons of peanuts are grown yearly in the United States, the demand is greater than the supply and consequently large quantities of nuts are imported.

Concerning the manufacture of peanut oil, Lewkowitsch † states that the nuts are shelled by special machinery. The kernels, which contain 43 to 45 per cent of oil, are ground and the oil expressed from the ground material by hydraulic pressure, two and sometimes three times. The first expression is carried out at the ordinary temperature, the second at about 31° C., and the third at about 52° C.

The cake serves as an excellent cattle food, as it contains the highest amount of proteins of all known oil cakes; moreover, these proteins are more easily digested than those of other cakes.

Thorpe † states that the average composition of the nuts obtained from various places is as follows:

	Per cent.
Arachis oil	38 to 50
Water	4.6 to 12.8
Albuminoids	26 to 31
Carbohydrates	5 to 19
Fibre	1.1 to 4.1
Ash	1.6 to 3.0

Mitchell ‡ gives the following constants for peanut oil:

Specific gravity	0.917 to 0.9256
Reichert-Meissl value	0.48
Hehner value	95.5
Iodine value	92 to 100.8

The principal fats which peanut oil contains are olein, linolin, palmitin, stearin, arachidin, and lignocerin.

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* Thorpe, E., Dictionary of applied chemistry. Volume 1, page 286.

† Lewkowitsch, J., Oils, fats, and waxes. Volume 2, page 304.

‡ Mitchell, C. A., Edible oils and fats. Page 58.

Genus PACHYRRHIZUS

PACHYRRHIZUS EROSUS (L.) Urb. SINGKAMÁS.

Local names: *Hingkamás* (Cavite); *kamáh* (Zambales); *kamás* (Ilocos Norte and Sur, Abra, Pangasinan); *lakamás* (Pangasinan); *sikamás* (Pampanga); *sinkamás* or *singkamas* (Ilocos Norte and Sur, Cagayan, Pangasinan, Tarlac, Bulacan, Bataan, Rizal, Manila, Laguna, Tayabas, Cavite, Batangas, Camarines, Albay, Mindoro, Capiz); *tikamás* (Cuyo Island).

SINGKAMÁS OIL

Heyne[*] says that Greshoff found in the seeds 38.4 per cent of a colorless, limpid oil.

Pachyrrhizus erosus is a rather coarse, somewhat hairy, herbaceous vine. The leaves are compound with three leaflets, which are up to 15 centimeters in length and 20 centimeters in width. The flowers are pale blue or blue and white, 2 to 2.5 centimeters long, and borne in racemes which are up to 45 centimeters in length. The pods are about 10 centimeters long, 10 to 12 millimeters wide, flat, hairy, and contain from eight to ten seeds. The roots are large, fleshy, turnip-shaped. They are either eaten raw or prepared in a variety of ways. The young fruit is sometimes eaten as a vegetable.

This species is a native of tropical America, but is now widely distributed in the tropics. It is thoroughly naturalized in the Philippines and is common in thickets. It is also extensively cultivated.

Genus PITHECOLOBIUM

PITHECOLOBIUM DULCE (Roxb.) Benth. KAMACHÍLE.

KAMACHILE OIL

A description and the local names of this species are given in the bulletin on edible plants.

Concerning the oil yielded by the fruit of this species Kesava-Menon[†] states:

> * * * The fruit * * * contains a number of large seeds each of which is enveloped in a sweet, whitish pulp. The seeds are black, shiny, partly immersed in an arillus, and replete with an edible pulp of an yellowish white colour. The pulp on extraction with ether yielded 18.22 per cent of a yellowish white oil, with a beany smell, which solidified at a temperature of 15° C. (=13.20 per cent calculated on the whole seed). The expressed oil is yellowish white, and very viscous, and "stearine" deposits on standing. The kernels form 72.4 per cent of the seed. Church (Dictionary of the Economic Products of India, Watt, Vol. VI, Part I, page 282) states that 100 parts of bean contain: water,

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[†] Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 2 (1916), page 346.

[†] Kesava-Menon, A., Some Indian oils and fats. Journal of the Society of Chemical Industry, Volume 29 (1910), No. 24, page 1431.

13.5 parts; albuminoids, 17.67 parts; starch, 41.4 parts; fatty matter, 17.1 parts; fibre, 7.8 parts; ash, 2.6 parts.

Physical and chemical characteristics of Pithecolobium dulce—

Fat: Specific gravity (d 100/100) = 0.9106; (d 100/15) = 0.8756. Acid value, 63.9. Saponification value, 205.9. Reichert-Meissl value, 8.41. Titration no. of insol. vol. acids, 1/10 KOH, 0.34. Iodine value, 56.60. Unsaponifiable matter per cent, 1.17. Butyro-refractometer at 25° C. "Degrees," 69.5; at 40° C., 62.0.

Fatty acids: Per cent, 87.64. Melting point, 44.7° C. Iodine value, 57.59; neutralization value, 198.7. Mean molecular weight, 282.2.

Genus PONGAMIA

PONGAMIA PINNATA (*P. mitis*) (Linn.) Merr. (Fig. 39). BÁNI.

Local names: *Balobaló* (Zamboanga, Basilan); *balik-balík* (Tagalog); *baluk-balúk, balutbalút, magit* (Cotabato); *baobaó* (Agusan); *báni* (Pangasinan, Zambales, Pampanga, Bataan, Cotabato); *kadél* (Tayabas); *marokbarók* (Bikol); *salingkugi* (Zamboanga).

PONGAM OIL

The seeds of this tree yield a red-brown, thick oil known as pongam oil. It is employed for illuminating and medicinal purposes and should also be useful for the manufacture of soap and candles. According to Lewkowitsch * the oil has the following constants:

Specific gravity at 40°	0.9352
Saponification value	178.0
Iodine value	94.0
Refraction index at 40° (butyro refractometer degrees)	78.0

Concerning this oil Watt † says:

> According to Lepine (*Pharm. Journ.* (*3*) *XL., 16*), the seeds yield 27 per cent of a yellow oil, having a sp. gr. of 0.945 and solidifying at 8°C. It has been examined by the authors of the *Pharmacographia Indica*, who write: "The oil which we have examined (called *Houge* oil in Mysore), and expressed purposely from fresh seeds, was thick, of a light orange-brown colour, and bitter taste. The sp. gr. at 18°C was 0.9458. It yielded 93.3 per cent of fatty acids melting at about 30°. With sulphuric acid it became yellow with orange streaks, and when stirred formed an orange-red mixture, which, after standing, became yellow. With nitric acid it formed an orange emulsion. With the elaïdin test it remained liquid for several hours, and was of the colour and consistence of honey after two days. The fresh oil deposits solid white fats if kept at the temperature of 16° for a few weeks, and the clear oil then has the specific gravity of 0.935. The bitter principle of the oil appears to reside in a resin, and not in an alkaloid as is the case with Margosa oil.

Pongamia pinnata is a tree reaching a height of 15 meters and a diameter of about 45 centimeters. The leaves are alternate and compound with three to seven leaflets, which are smooth, pointed at the apex, usually rounded at the base, and 7 to 10 centimeters in length. The flowers are purplish, about 1.5 centimeters in length, and borne in racemes. The pods are somewhat flattened, somewhat oval in outline, and with a single seed.

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* Lewkowitsch, J., Oils, fats, and waxes, Volume 2 (1915), page 498.

† Watt, G., A dictionary of the economic products of India, Volume 6 (1892), page 323.

This species is distributed from northern Luzon to southern Mindanao.

Genus TAMARINDUS

TAMARINDUS INDICA L. SAMPÁLOK.

TAMARIND-SEED OIL

A description, figure, and the local names of this species are given in the bulletin on edible plants.

Lewkowitsch * says that in famine times the seeds are universally eaten by the poorer classes of India, and that they yield 4.5 per cent of oil which has the following constants:

Saponification value	183
Iodine value	87.1

Hefter † states that the seeds yield 15 per cent of oil.

According to Watt: ‡

> An oil of an amber colour, free of smell and sweet to the taste, is prepared from the seeds by expression. This oil appears to have been brought to notice for the first time in 1856, when a Captain Davies sent a sample to the Agri.-Horticultural Society of India, with the remark that it was, in his opinion, suitable for culinary purposes. The Society's Sub-Committee reported favourably on the oil, and suggested that it might be found useful in the preparation of varnishes and paints, as well as for burning in lamps. A member of the Committee remarked that it was occasionally employed in Bengal for making a varnish to paint idols, and for finishing *kurpa* cloth, but that it was very little appreciated. The Sub-Committee further noticed that the sample submitted to them had an odour of linseed-oil, but Captain Davies explained that this was not a property of the oil itself, but was due to the mill in which it had been expressed, having been one ordinarily employed for making linseed-oil (*Agri.-Hort. Soc. Ind., Journ., 1885*). The authors of the *Pharmacographia Indica* have examined it, and write, "Braunt states that the seeds contain 20 per cent of a thickly fluid oil with an odour of linseed, and classes it with the non-drying oils. By expression from the dry seeds, we were unable to obtain any oil, and by solvents the yield was only 3.9 per cent. The oil possessed greater siccative properties than boiled linseed oil." The subject appears to be well worthy of further investigation,

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* Lewkowitsch, J., Chemical technology and analysis of oils, fats, and waxes, Volume 2 (1914), page 238.

† Hefter, G., Technologie der Fette und Öle (1908), Volume 2, page 466.

‡ Watt, G., Dictionary of the economic products of India, Volume 6, Part 3 (1893), page 405.

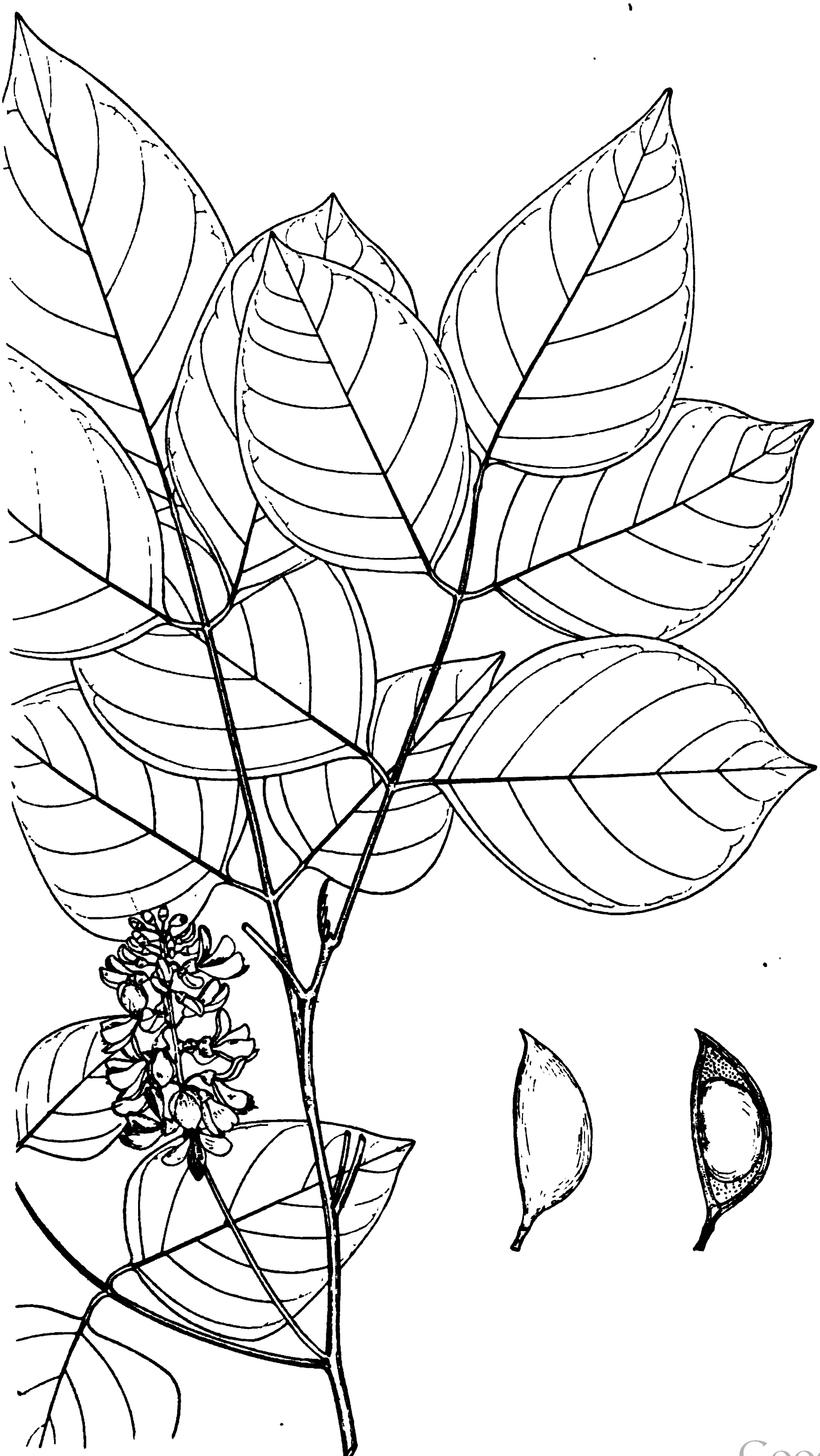

FIGURE 39. PONGAMIA PINNATA (BANI), THE SOURCE OF PONGAM OIL. ×⅓.

the more so from the contradictory nature of the literature regarding it, for the seeds might be obtained in any quantity and cheaply, should the oil prove of commercial value.

Family SIMARUBACEAE

Genus SAMADERA

SAMADERA INDICA Gaertn. MANUNGGÁL.

Local names: *Malunggál* (Mindoro); *manunggál* (Cagayan, Lanao).

MANUNGGÁL OIL

Heyne * says that Greshoff reports an oil content of one-third of the weight of the seed kernels. Heyne also states that the plant bears fruits in three years.

Samadera indica is a tree reaching a height of about 10 meters and a diameter of about 20 centimeters. The leaves are alternate, leathery, somewhat oval, pointed at both ends, and from 12 to 20 or more centimeters in length. The fruits are about 6 centimeters long, flattened, and inequilateral.

This species is distributed from Luzon to Mindanao and Palawan, but is apparently rare.

Family BURSERACEAE

Genus CANARIUM

Several species of the genus *Canarium* bear edible nuts which have a fine flavor and yield a valuable oil. The nuts are known as pili nuts. The largest are apparently produced by *Canarium ovatum* and these nuts are sold commercially as pili.

CANARIUM OVATUM Engl. (Fig. 40). PILI.

Local names: *Anánggi* (Sorsogon); *basiád, lipúti, piláuai* (Tayabas); *piláui* (Polillo); *píli* (Tayabas, Polillo, Camarines, Sorsogon, Samar, Surigao).

PILI NUTS AND PILI-NUT OIL

The nuts of this species are very rich in oil, and when roasted have a delicious flavor. They are served in the same manner as almonds, and by many are considered superior to the latter. The nuts are also used considerably in the making of confections. In Camarines, the roasted kernels are used to adulterate chocolate. The uncooked nuts have a purgative effect. In 1913, 1,186,173 kilograms of pili nuts were exported from Manila. The oil obtained from the nuts of *Canarium ovatum* is sweet, and suitable for culinary purposes. The fruits are 6 to 7 centimeters in length and consist of hard, thick-shelled, triangular nuts surrounded by a small amount of pulp. This pulp, which

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 3 (1917), page 23.

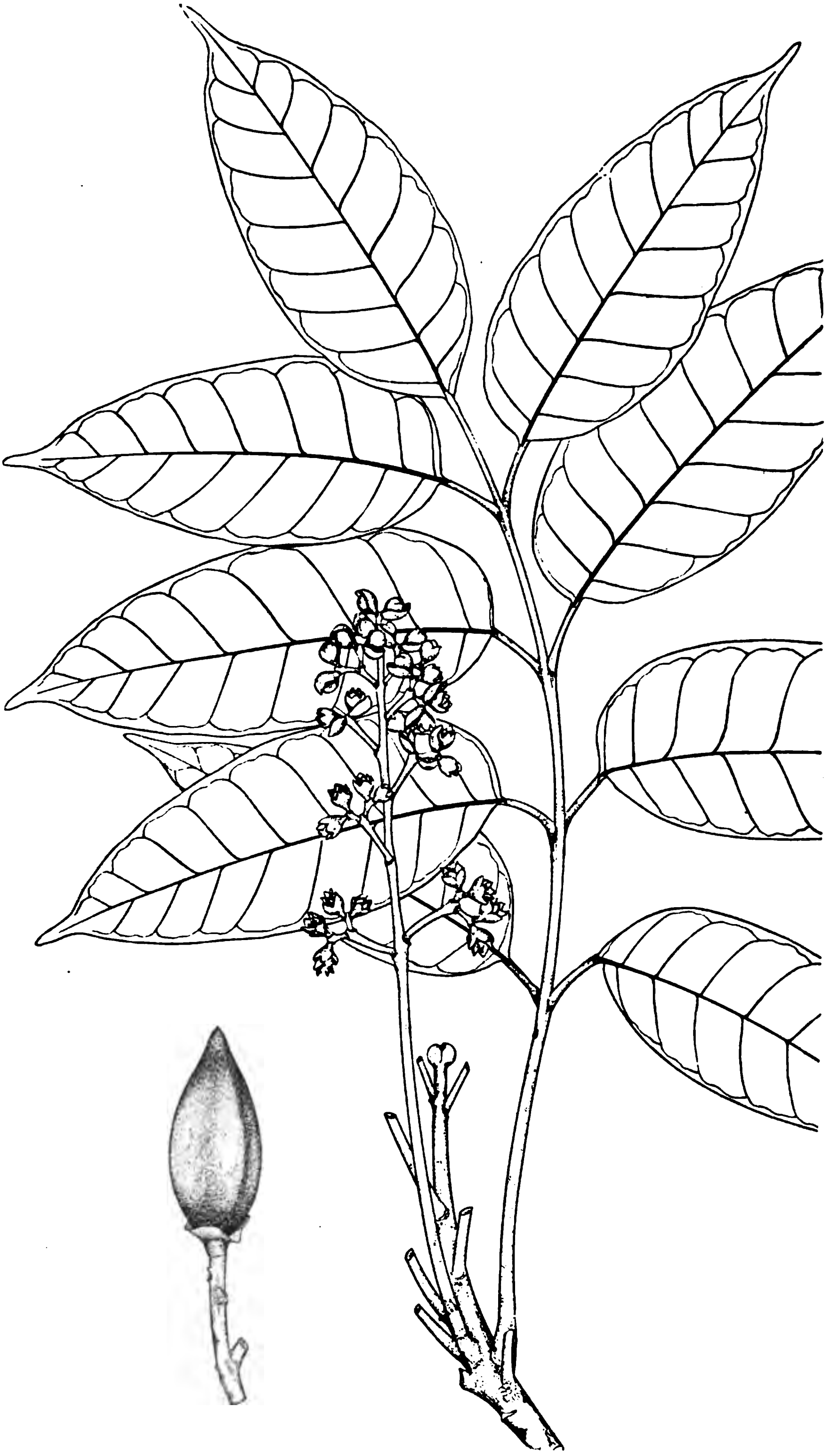

FIGURE 40. CANARIUM OVATUM (PILI). THE SOURCE OF PILI-NUT OIL.

is edible when cooked, also contains an oil which is occasionally extracted locally and used for lighting and in cooking. Its chemical properties have not been investigated.

Mr. E. Tabat, who kept a record of the yield of a number of trees, found that an average tree produced 33 kilos of nuts in one year. The cost of gathering the nuts was 2.5 centavos per kilo, and of husking them, 1.5 centavos per kilo.

Mr. Tabat tried three methods of removing the soft covering of the nuts and found that the best method was to place them in fresh water for at least 24 hours, after which the soft part was easily removed. If the fresh nuts were put in sacks and piled in a corner and the soft covering allowed to rot, many of the nuts were spoiled, apparently by the heat produced by the decay of the soft, outer coverings. This method also resulted in the loss of sacks. He found it inadvisable to remove the soft covering by means of hot water, as this frequently cooked the nuts, thus greatly impairing their keeping qualities.

Brill and Agcaoili * analyzed what they called long and short varieties of pili nuts from *Canarium pachyphyllum*. The results are recorded in Tables 12 and 13.

TABLE 12.—*Composition of the kernels of pili nuts.*

	Long.	Short.
	Per cent.	*Per cent.*
Moisture	2.79	2.90
Fat	74.39	72.53
Protein (N x 6.25)	12.06	11.88
Sucrose	0.88	0.66
Reducing sugars	0.45	1.35
Starch (by difference)	4.33	5.11
Crude fiber	2.15	2.42
Ash	2.97	3.15

TABLE 13.—*Chemical constants of pili oil.*

	Long.	Short.
Specific gravity at 30° C	0.9067	0.9067
Butyro refractometer reading at 30° C	54-54.2	54-54.2
Iodine value (Hanus)	61.25	59.61
Reichert-Meissl value	3.3	2.2
Saponification number	192.6	186.8
Free fatty acids (oleic) per cent.	7.62	8.84
Acid value cc. N/10 NaOH	2.70	3.13

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* Brill, H. C., and Agcaoili, F., Philippine oil-bearing seeds and their properties: II. Philippine Journal of Science, Section A, Volume 10 (1915), page 110.

This species, like *Canarium luzonicum,* yields Manila elemi, for a discussion of which see *Canarium luzonicum,* in the section on resins.

Canarium ovatum is a tree reaching a height of about 20 meters and a diameter of about 40 centimeters. The leaves are alternate and compound with opposite leaflets, which are smooth, rounded at the base, pointed at the tip, and from 10 to 20 centimeters in length. The flowers are greenish, fragrant, and about a centimeter long.

This species is very abundant in southern Luzon.

Family MELIACEAE

Genus CHISOCHETON

CHISOCHETON CUMINGIANUS Harms. (Fig. 41). BALUKANÁG.

Local names: *Balita* (Bukidnon sub-province;) *balukanág* (Laguna, Camarines, Catanduanes Island); *batuákan* (Benguet, Union); *bayongbói* (Nueva Vizcaya); *diualat* (Tayabas); *dudós* (Albay); *kalimotáin* (Laguna); *káto* (Bataan); *makalsa* (Negrito in Cagayan); *malakalád* (Negros Oriental); *maramabólo* (Cagayan); *pakalsa* (Cagayan); *salagin* (Laguna).

BALUKANÁG OIL

This species produces a nut averaging 3 centimeters in length and 2.5 centimeters in width. The nut contains a considerable percentage of non-drying oil. It is reported to have been, before petroleum became common, the chief source of illuminating oil in certain regions. The nuts have rather hard shells which, according to Brill and Agcaoili,* constitute about 60 per cent of the total weight of the seed and are somewhat difficult to separate from the meat. They found that 1 kilogram of shelled nuts after drying weighed 698 grams, and yielded by extraction with petroleum ether 308 grams, or approximately 31 per cent of the fresh kernels, of a reddish-brown oil which had the specific gravity 0.9203 at 15.5° C.

The dried kernels had the following composition:

	Per cent.
Fat (by extraction)	44.12
Protein (N x 6.25)	9.00
Ash	3.19

By expression of the dried kernel, Brill and Agcaoili obtained 35.56 per cent of balukanág oil. According to them, the oil has a rancid odor, is non-drying, and has purgative properties. The laxative effect of 5 parts of this would be approximately equivalent to one part of castor oil. These writers state that the soap-making quality of this oil was tested by the Bureau of Science with gratifying results and that the oil is now being used by at least one firm in Manila in this industry.

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* Brill, H. C. and Agcaoili, F., Philippine oil-bearing seeds and their properties: II. Philippine Journal of Science, Section A, Volume 10 (1915), page 107.

Balukanág oil has the following chemical constants:

Specific gravity at 15° C.	0.9203
Specific gravity at 30° C.	0.9188
Butyro refractometer (reading at 30° C.)	60–61
Iodine value (Hanus)	80.78
Reichert-Meissl value	7.34
Saponification number	192.02
Free fatty acids (oleic) per cent	3.98
Acid value cc. N/10 KOH	7.06

Chisocheton cumingianus is a tree reaching a height of 20 meters and a diameter of 45 centimeters. The flowers are fairly numerous, on long inflorescences. The leaves are compound with leaflets about 20 to 25 centimeters in length. The fruit is pear-shaped and when dry is about 8 centimeters in diameter. It contains nuts averaging 3 centimeters in length and 2.5 centimeters in width.

This species is distributed from northern Luzon to Mindanao.

CHISOCHETON PENTANDRUS (Blco.) Merr. (Fig. 42). KÁTONG-MACHÍN.

Local names: *Igíu* (Tayabas); *kátong-bakálau, malatumbága, kátong-machín* (Bataan); *pamalat'áñgen* (Cagayan).

KÁTONG-MACHÍN OIL

Oil extracted from the fruit of this species is used locally as a hair cosmetic.

Chisocheton pentandrus is a tree reaching a height of 30 meters and a diameter of 40 centimeters. The leaves are alternate and compound. The leaflets are opposite, pointed at the tip, rounded at the base, and 7 to 14 centimeters in length. The flowers are small and are borne on long-branched inflorescences. The fruits are round, red, hairy, and about 1.5 centimeters in diameter.

This species is distributed throughout the Archipelago.

Genus XYLOCARPUS

XYLOCARPUS MOLUCCENSIS Lam. PIAGÁU.

PIAGÁU OIL

A description and figure of this species and its local names are given in the bulletin on mangrove swamps.

Heyne * says that, according to Wijs, the seeds contain 40 to

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 3 (1917), page 45.

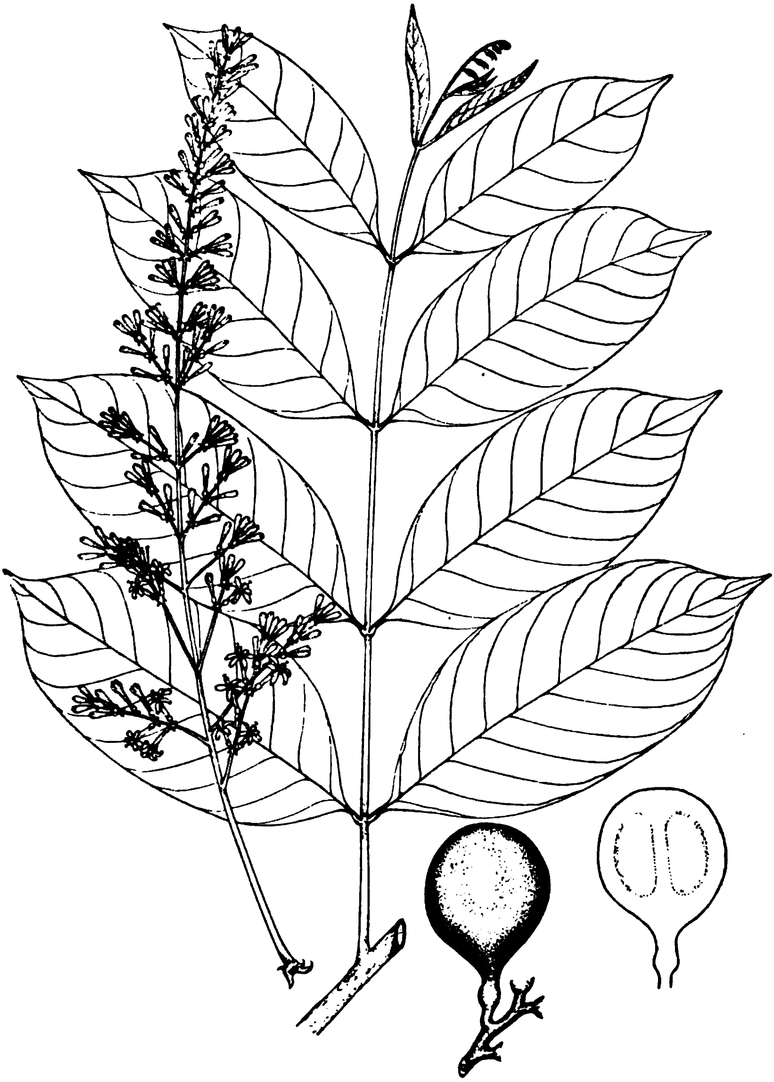

FIGURE 41. CHISOCHETON CUMINGIANUS (BALUKANAG), THE SOURCE OF BALUKANAG OIL. ×½.

60 per cent of solid fat with a strong, bitter taste, which can be removed by prolonged boiling with water. The odor is slightly acid and somewhat aromatic.

According to Watt: *

> The seeds yield, on expression, a whitish semi-solid fat. This remains fluid only at high temperatures. It is used as a hair-oil, and also for burning purposes.

Family EUPHORBIACEAE

Genus ALEURITES

TUNG OIL AND LUMBANG OILS

This genus contains a number of species with nuts which yield a valuable oil. Perhaps the best known of these oils is Chinese wood oil or tung oil. This is derived from at least two Chinese species of the genus, *Aleurites fordii* Hemsley and *A. montana* Wilson, which do not occur in the Philippines. Tung oil, which has properties quite similar to those of the Philippine lumbang oils, has been investigated quite extensively, and for this reason a short account of this important oil has been included.

Tung oil is used in large quantities for the preparation of paints, varnishes, linoleum, and for other similar purposes. According to Brill and Agcaoili † 5,000,000 gallons of Chinese wood oil were imported from China into the United States in 1911. These writers state that 40,000 trees have been planted in the southern states by American paint concerns.

As regards the importance of tung oil, the Oil, Paint, and Drug Reporter ‡ states:

> * * * In recent years this oil has revolutionized the varnish industry of the United States, for it has made possible the manufacture of a quick-drying varnish that is less liable to crack than that made from kauri gum. Tung oil has also been found of special value in waterproof priming for cement. * * *

EXTRACTION METHODS

The Chinese methods employed for extracting the oil, although crude, are effective. After the seeds are removed from the husks they are placed in a circular stone trough, where they are crushed by a stone roller drawn by a buffalo, cow, or ass. The pulverized meal is partially roasted in shallow pans, then steamed over boiling water, the product meantime

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* Watt, G., Dictionary of the economic products of India, Volume 2 (1889), page 141.

† Brill, H. C. and Agcaoili, F., Philippine oil-bearing seeds and their properties: II. Philippine Journal of Science, Section A, Volume 10 (1915), page 113.

‡ Oil, Paint, and Drug Reporter, Volume 91, February 12, 1917, page 48L.

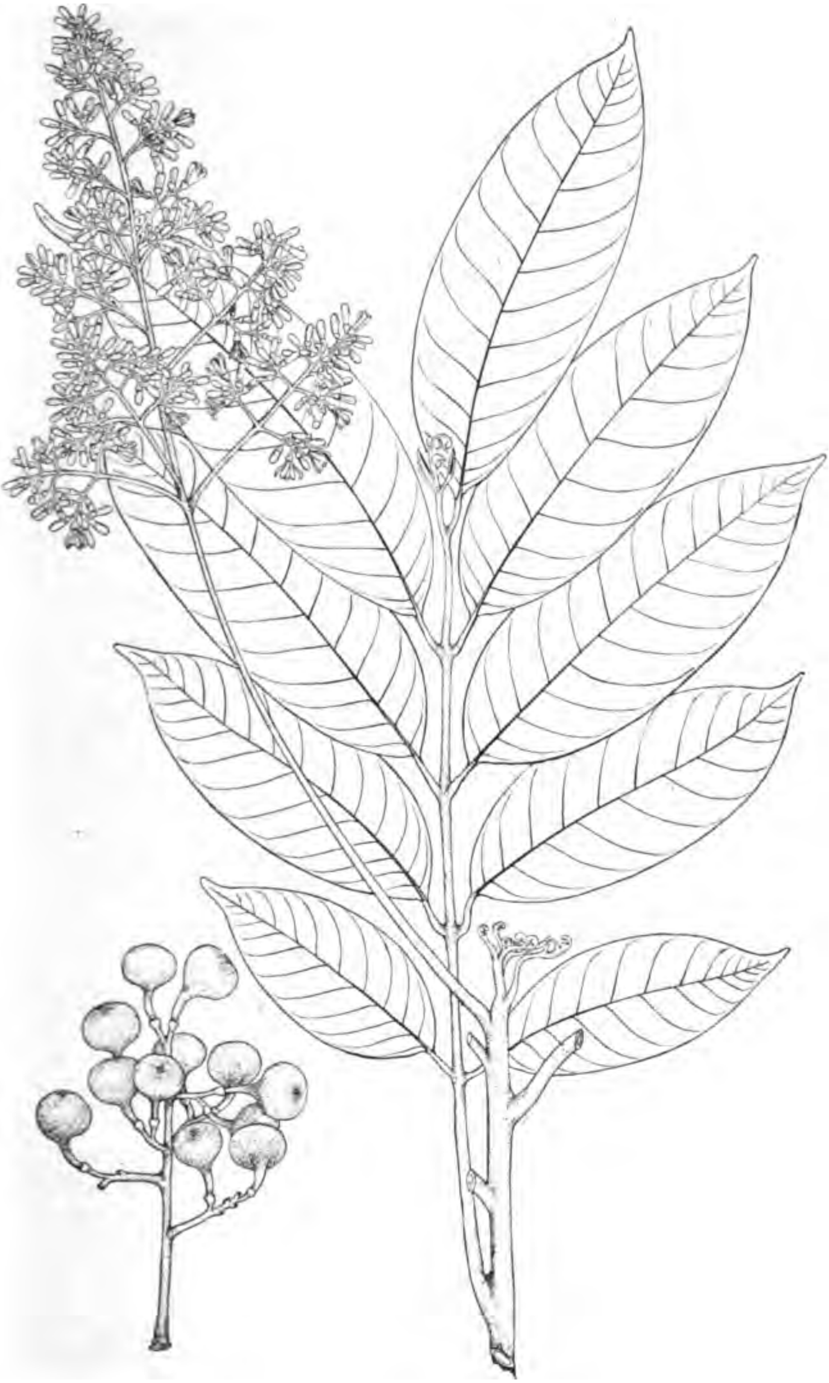

FIGURE 42. CHISOCHETON PENTANDRUS (KATONG-MACHIN), THE SOURCE OF KATONG-MACHIN OIL. X½

being placed in wooden vats fitted with wicker bottoms. The nuts are next placed in steel frames with straw as an outside container. The frames are arranged on edge in a press and pressure is applied. This is usually accomplished by means of a system of wedges which are driven in one after another by means of a huge battering-ram until the brown, watery, and odoriferous oil is crushed out into the vat below. As a rule the oil is then slightly heated and strained through a coarse grass cloth. (If the heating process is carried too far the oil becomes dark brown instead of retaining its desired light-yellow color.) The product is then placed in wicker baskets lined with varnished paper and is ready for shipment. As a rule the oil yield is about 40 per cent of the original weight of the kernels. The refuse matter, which is in the form of cakes, is used as a fertilizer.

In the vicinity of Hankow the native dealers allow the oil to again precipitate, drawing off the clear liquid and selling it to the foreign exporting firms. The residue is then sold to small dealers in Wuchang and Hanyang, who once more skim the oil after a further precipitation process. The oil is then sold to the native boatmen for use on their craft.

About the only variation in the above method of oil extraction is that in cold weather, when the oil congeals to a grease stage, it is necessary to heat the mass slightly in order to allow precipitation to take place. This is usually accomplished by steam coils being placed within the containing tank. Under this treatment the product soon liquifies, the foreign matter drops to the bottom, and the clear liquid is drained off through stopcocks placed just high enough to avoid the thick, muddy sediment at the bottom.

VARIED USES OF THE OIL

T'ung-yu is widely used throughout China as a paint oil for outside purposes. It is held that as a drying oil it excels even linseed oil. One of its greatest local markets is found among the native boatmen, who never paint their boats but coat them with the cruder grades of wood oil, which not only give the woodwork a bright, lustrous finish but also act as an excellent preservative. When certain mineral substances known as t'utzu and t'o-shen are added to the wood oil and the resulting mass heated for about two hours a varnish called kuang-yu is produced which is valuable as a water-proofing substance when placed on silks, pongees, and the like.

T'ung-yu is also used as an adulterant in the manufacture of lacquer varnish, as an illuminant, and as an ingredient in concrete, and when mixed with lime and bamboo shavings it is used by the natives in calking their boats. The so-called Chinese or Indian ink is made from the soot resulting from the burning of the oil or the fruit husks. The product is also used as a dressing for leather, in the manufacture of soap, and as a varnish for fine furniture. It is chiefly used in foreign countries for the manufacture of varnish from cheap gums. Other oils require a higher and more expensive quality of gum in order that the resulting varnish be of equal grade. This feature, together with the rapidity with which wood-oil varnish dries, has caused the demand for the product to steadily increase.

According to Ennis: *

China wood oil is rapidly becoming conspicuous as a linseed oil substitute in the varnish trade. * * * The consumption of the oil in the

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* Ennis, W. D. Linseed oil and other oils (1909), page 235.

United States has been steadily increasing. There are two grades of the oil, one yellow and the other darker. * * * The oil is extremely poisonous and, as received from the Chinese, subject to heavy adulteration. * * * The crude oil dries with extreme rapidity, but with an opaque film, due to the presence of mucilaginous matter, which also causes the oil to become waxy at low temperatures, when organic compounds analogous to stearates settle out. It cannot be used in its raw state, but is always chemically treated. It may be "boiled" with lead or manganese dryers, with rosin or with resinates, to hasten oxidation, but must not be heated above 350 degrees F., at which temperature it suddenly thickens to an insoluble gelatine-like substance which cannot be softened again. It is nearly always used in a mixture with linseed oil. Its characteristic lard-like odor may be detected in solutions as weak as 10 per cent.

Brown * gives analyses and specifications of high-grade Chinese wood oil and also the correction factor for calculating the specific gravity at different temperatures.

Stevens of Irvington, N. J., and Armitage † of Newark, N. J., have compiled a very extensive bibliography of Chinese wood oil which they claim comprises the entire literature on the subject. This is issued in two volumes, each consisting of two parts which are really volumes in themselves.

In the Philippines, oil is obtained from two species of this genus, *Aleurites moluccana* (lumbang) and *Aleurites trisperma* (bagilumbang). These oils have been studied by Brill and Agcaoili, who believe that either could be substituted for tung oil, as they are quick-drying and give a clear, transparent, non-sticking film on a surface when exposed to the air for a short time. If the Philippine oils are placed on the market, they will probably be used primarily for the same purposes as tung oil. The oil obtained from *Aleurites trisperma* is almost indistinguishable from tung oil for the uses which the latter chiefly serves, while that obtained from *Aleurites moluccana* is possibly slightly inferior to tung oil, although superior to linseed oil.

Tung oil heated to a temperature of about 200° to 250° solidifies, and in this condition is unsuitable for making varnishes. We have found that oil from *Aleurites moluccana* or *A. trisperma* may be heated to about 315° at which temperature it distills and does not solidify until about one-third has been volatilized. In so far as this property is concerned the Philippine lumbang oils are more suitable for varnish making than is tung oil.

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* Brown, F., Chemical News, Volume 114 (1916), page 123.

† Stevens, G. H., and Armitage, J. W., Patents, technology and bibliography of China wood oil (tung oil), 1914.

Aguilar,* who also has made a study of the Philippine oils, says that lumbang oil is similar to linseed oil in its properties as a paint vehicle, and that, like linseed, it has certain disadvantages for use in red-lead paints. Bagilumbang oil cannot be used as a paint vehicle, especially with red lead, as it dries into a paste. Aguilar found that a mixture of the two oils, containing 25 to 50 per cent of lumbang oil makes a good paint vehicle for red lead. The *Aleurites* oil so far produced in the Philippines is almost entirely the product of *Aleurites moluccana*, which is fairly abundant in a wild state in many parts of the Philippines, and is also planted. *Aleurites trisperma* is reported from many localities, but is probably not so abundant. Both species can be grown readily in plantations.

The Bureau of Forestry is using large numbers of both species in its reforestation projects and is also distributing seed and encouraging other people to plant these species. It is safe to say that at the present time the yearly planting of these species amounts to between 400,000 and 500,000 trees. From these figures it would seem reasonable to predict that in the near future large quantities of *Aleurites* oil will be available in the Philippines. During the year 1918, 184,428 kilograms of *Aleurites moluccana* oil valued at 129,838 pesos were exported from the Philippines.

That there would be a market for considerable quantities of *Aleurites moluccana* (lumbang) oil is shown by the fact that one American concern, which has experimented with this oil, has inquired as to the possibility of obtaining 4,000 tons per month.

ALEURITES MOLUCCANA (L.) Willd. (Figs. 43–45). LUMBÁNG.

Local names: *Biáo* (Misamis, Davao); *lumbáng* (Rizal, Laguna, Zamboanga, Batangas); *lumbang-bató* (Cavite).

LUMBÁNG OIL.

The oil of *Aleurites moluccana* is known in the Philippines as lumbang oil. This species is distributed through Polynesia, the Malayan region, and the Hawaiian Islands. In Hawaii the oil is called kukui or candle-nut oil. The latter name is also used in other parts of the world. According to Wilcox and Thompson † the Hawaiians strung the nuts on sticks and used

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* Aguilar, R. H., The lumbang oil industry in the Philippine Islands. Philippine Journal of Science, Volume 14 (1919), pages 275–285.

† Wilcox, E. V. and Thompson, A. R., The extraction and use of kukui oil. Hawaii Agricultural Experiment Station, Press Bulletin 39 (1913).

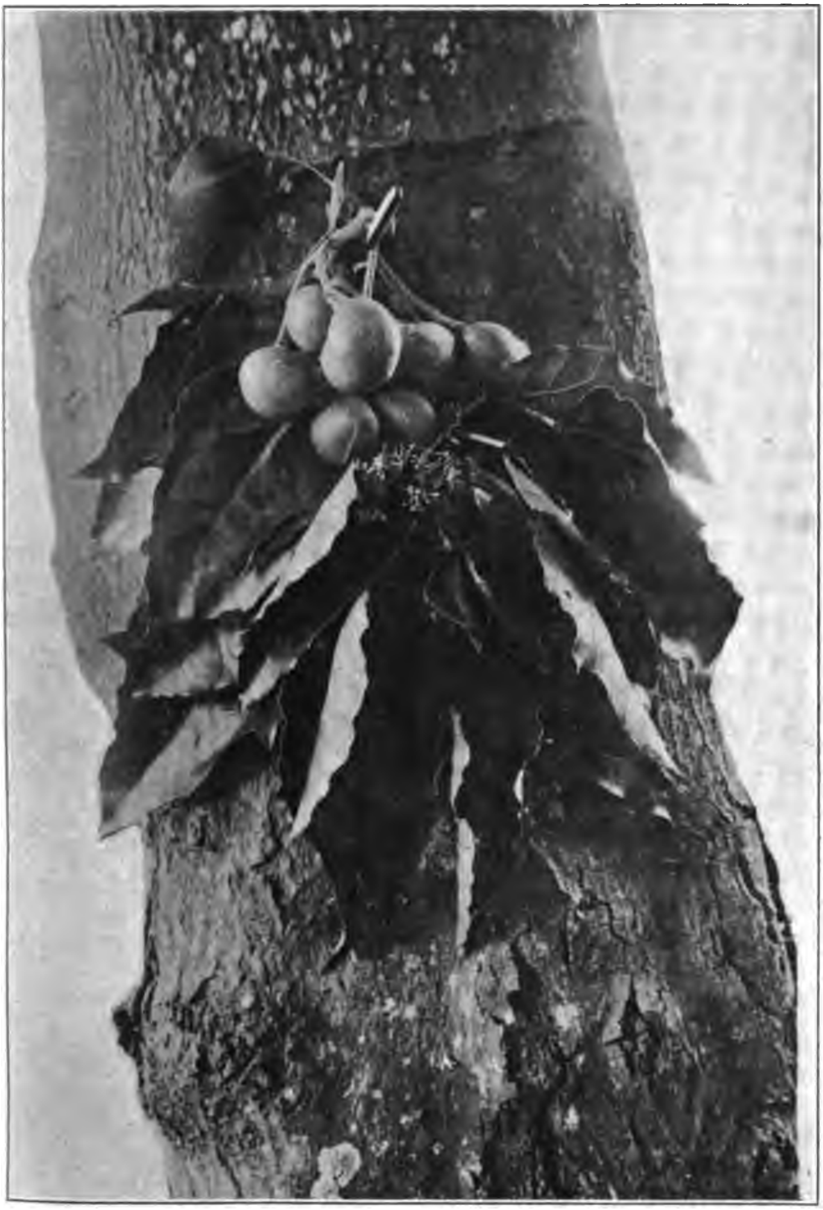

FIGURE 43. ALEURITES MOLUCCANA (LUMBANG), THE SOURCE OF LUMBANG OIL. BARK, FRUITS, AND LEAVES.

them for lighting their houses. This use of the kernels gave rise to the name "candle nut."

Lumbang is a drying oil and in this respect resembles linseed oil and also the Chinese wood oil (tung oil). Lumbang oil is used for various purposes, such as the preparation of paints, varnishes and linoleum, illumination, soap manufacture, wood preservation, etc.

Lumbang oil has been manufactured in the Philippines in very primitive mills for years, and is used locally for mixing paints, for protecting bottoms of dugout canoes and other small craft against water and marine borers, and for illumination.

According to Richmond and Rosario,* who examined the Philippine nuts, the whole nuts are composed of 66 per cent of shells and 34 per cent of kernels, and the kernels contain 52 per cent of oil. Wilcox and Thompson † state that the whole nut contains 67 per cent of shells and 33 per cent of kernels, and that the kernels contain 60 per cent of oil. Lewkowitsch ‡ reports that some samples of lumbang kernels contain 62.25 per cent of oil and others 58.6 per cent.

The oil manufactured locally is made in a few Chinese shops in Manila, with primitive hand apparatus. The nuts are hot-pressed to save labor, but it is said that cold-pressing produces a better grade of oil.

The nuts of *Aleurites moluccana* have very hard shells which are difficult to crack; and, moreover, it is difficult to separate the kernel from the shell. A common procedure is to crack the nuts and pick out the kernels by means of a pointed instrument, a very tedious operation. Aguilar § mentions the following methods which are also used to separate shell from kernel:

> In some localities the Chinese place large quantities of nuts on the ground, cover them with straw and after burning the straw immediately sprinkle the nuts with cold water. They claim that with this method the nuts burst. In Laguna, Tayabas, and Batangas Provinces, the nuts are placed in tanks of boiling water and left there for from five to six hours. This loosens the kernel, and when sufficiently cool the nuts are cracked and the kernels are separated from the shells. These two methods produce brown kernels from which only brown oil can be expressed.
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> In Moro Province, along the coast of Davao, the nuts are dried in the

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* Richmnd, G. F., and Rosario, M. V. del, Commercial utilization of some Philippine oil-bearing seeds: preliminary paper. Philippine Journal of Science, Volume 2 (1907), pages 439 to 449.

† Wilcox, E. V., and Thompson, A. R., The extraction and use of kukui oil. Hawaii Agricultural Experiment Station, Press Bulletin 39, (1913).

‡ Lewkowitsch, J. Oils, fats, and waxes (1915).

§ Aguilar, R. H., The lumbang oil industry in the Philippine Islands. Philippine Journal of Science, Volume 14 (1919), page 275.

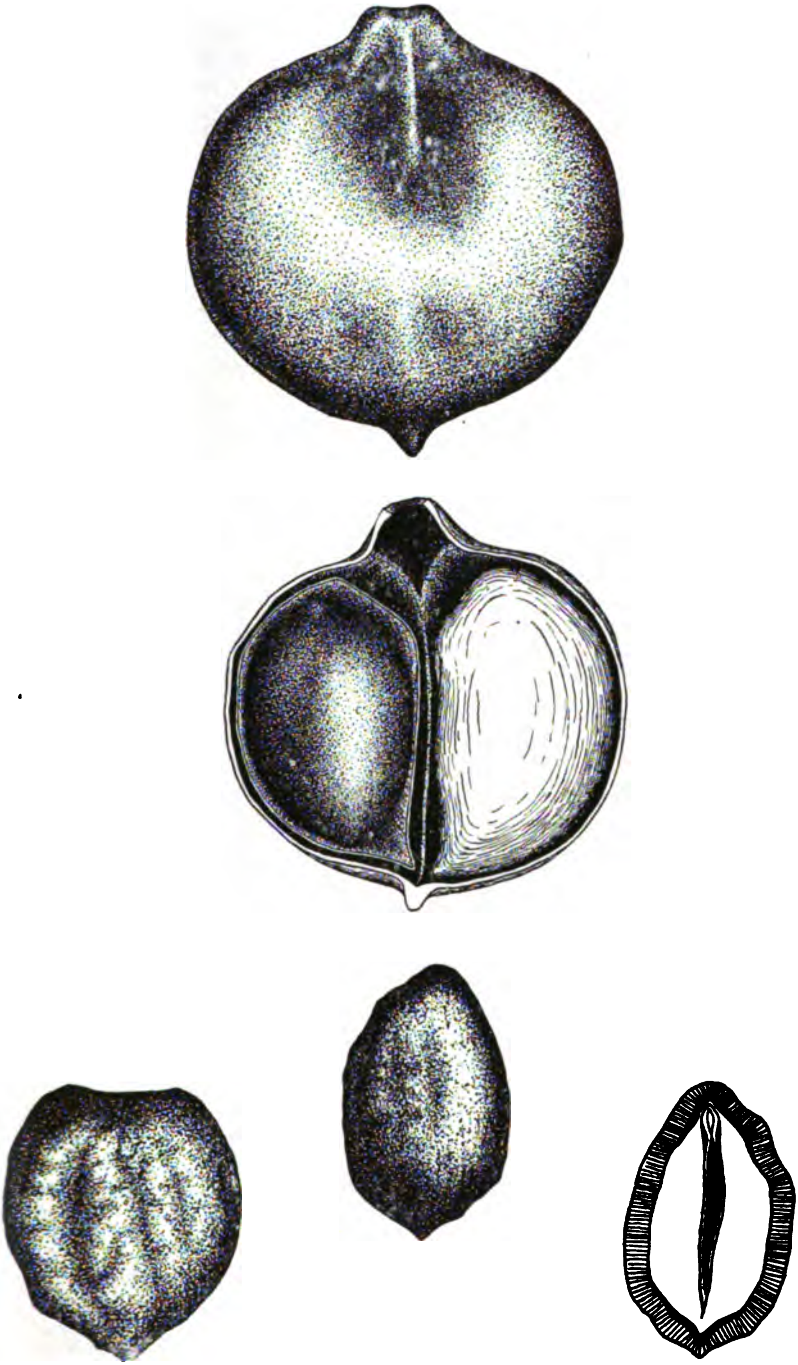

FIGURE 44. ALEURITES MOLUCCANA (LUMBANG), THE SOURCE OF LUMBANG OIL. DRIED FRUITS AND SEEDS. NATURAL SIZE.

sun until the kernels loosen sufficiently, which may be ascertained by occasionally cracking a few nuts for trial. The drying takes from five to ten days or more, depending upon the condition of the weather; the nuts are then cracked and the kernels removed. This process is very slow, although the kernel usually comes out whole and is of the best quality.

Aguilar has developed the following method: Nuts are heated in an oven at 95 degrees for three or four hours and then placed in cold water and left overnight. By the next morning most of the shells have burst and the kernels are picked out without much difficulty. This method, he says, has no injurious effect on the oil.

The following methods of removing the shells from the seeds are in practice in the Province of Laguna. The seeds are placed over a fire for from 72 to 120 hours, at the end of which time the shells are cracked, or they are spread in the sunshine until cracks are visible in the shells. In both cases, after the shells crack, the seeds are thrown against a hard object, preferably a large stone, when the shells fall off in pieces. These methods give brown kernels.

It has been suggested that the nuts with the shells could be crushed and ground in an oil mill and the oil expressed from the ground material. Aguilar believes, however, that the best method is to separate the kernel from the shell and then extract the oil; as about 20 kilos more oil per ton of nuts may be extracted from the kernel than from the crushed nuts. At present the Chinese manufacturers sell the cake, which is left after the oil is extracted from the nuts, at a good profit. According to the results obtained by Aguilar (Table 14), the fertilizing value of the cake left from the crushed nuts would be so much reduced as to make it almost useless as a fertilizer.

TABLE 14.—*Fertilizing value of lumbang (Aleurites moluccana) cake.*

Constituents.	Cake from kernel.	Cake from crushed nuts.
	Per cent.	*Per cent.*
Moisture	11.13	8.46
Nitrogen (N_2)	8.86	1.25
Potash (K_2O)	1.67	0.68
Phosphorous (P_2O_5)	1.02	0.25

Aguilar has found that the nuts of *Aleurites moluccana* may be stored a year or more without any appreciable change in the amount or composition of the oil. However, when the kernels without the shells are stored, they are apt to be very severely

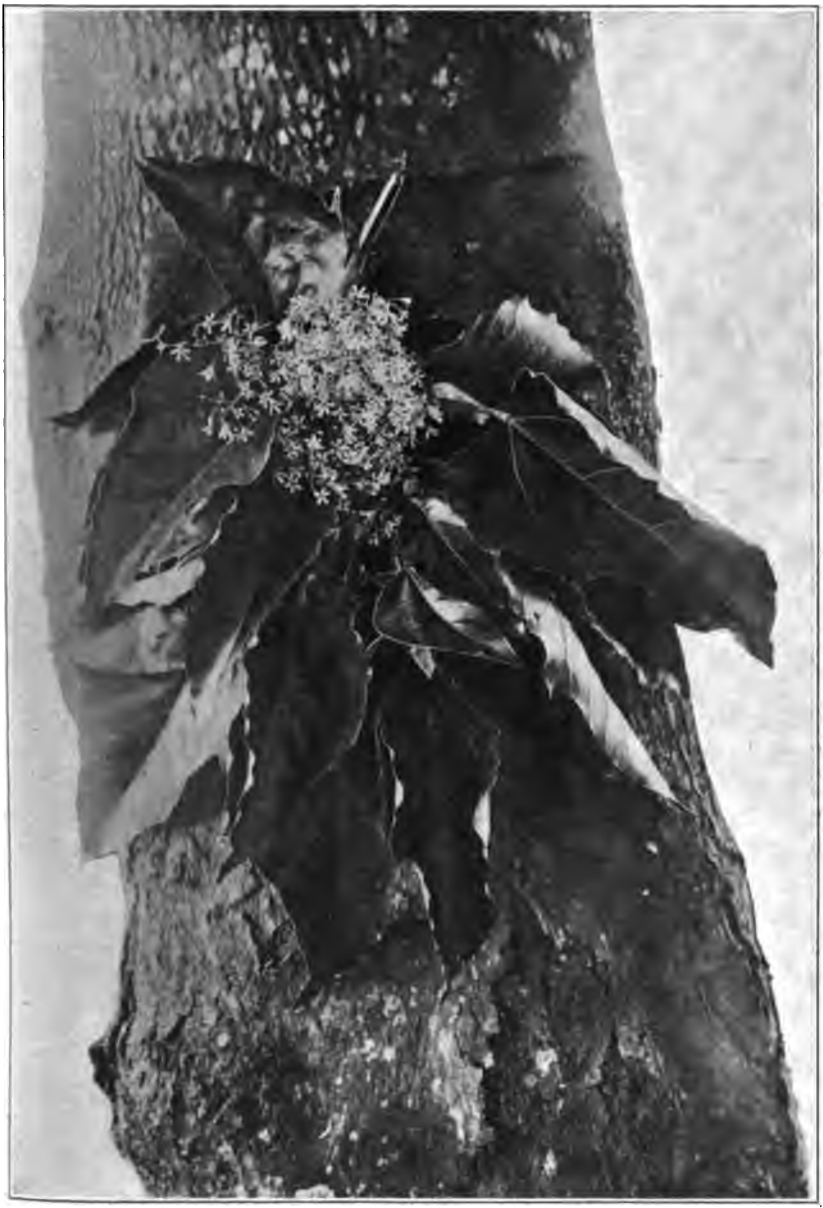

FIGURE 45. ALEURITES MOLUCCANA (LUMBANG), THE SOURCE OF LUMBANG OIL. BARK, FLOWERS, AND LEAVES.

attacked by small beetles, and the oil becomes more and more acid, although no change may be noticed in the appearance of the kernel and oil extracted. An actual test showed that the acidity of the oil was increased from 0.55 to 5.32 when the kernels were stored in a cold, dry place for one month. It is therefore advisable to extract the oil from fresh nuts.

Analyses of the kernels of *Aleurites moluccana* show that the principal constituents are oil (consisting largely of fat) and protein. The percentage of fiber and ash is very low. This is shown by the results recorded in Table 15.

TABLE 15.—*Analyses of lumbang kernels.*

Constituents.	Sample.	
	1.[a]	2.[b]
Water	5.00	8.23
Oil	62.175	59.93
Protein	22.65	8.04
Nitrogen free extract	6.83	17.62
Ash	3.345	3.56
Fiber	--------	2.62

[a] Semler, H., Die Tropische Agrikultur, Volume 2, page 515.
[b] Agricultural Gazette, New South Wales, Volume 17, (1906), page 859.

Lumbang oil has a light yellow color, and an agreeable odor and taste. It dries in thin films when allowed to stand several days. The results of various analyses of lumbang oil quoted by Wilcox and Thompson are given in Table 16. Aguilar also analyzed various samples of lumbang oil. His results are given in Table 17.

TABLE 16.—*Constants of lumbang oil (Wilcox and Thompson).*

Constants.	Sample.				
	1.[a]	2.[b]	3.[c]	4.[d]	5.[e]
Specific gravity 15° C	0.925	0.920-0.926	0.925	0.925	0.924
Acid value	1.72	--------	--------	0.97	0.5
Saponification value	204.2	184-187.4	192.6	194.8	189.5
Iodine value	139.7	136.3-139.3	163.7	114.2	152.8
Hehner value	96.4	--------	95.5	--------	95.2
Volatile acids	1.98	--------	--------	1.2	--------
Titer	17.8	--------	--------	--------	--------
Butyro-refractometer	--------	76-75.5 (15°C)	76 (25°C)	--------	--------

[a] Imperial Institute, Bulletin of Imperial Institute, Volume V (1907), page 135.
[b] De Negri, Journal of the Society of Chemical Industry, Volume XX (1901), page 909.
[c] Lewkowitsch, Journal of the Society of Chemical Industry, Volume XX (1901), page 909.
[d] Fendler, G., Journal of the Society of Chemical Industry, Volume XXIII (1904), page 613.
[e] Kassler, Journal of the Society of Chemical Industry, Volume XXII (1903), page 639.

TABLE 17.—*Constants of lumbang oil (Aguilar).*

Constants.	Oil extracted from fresh kernels.	Oils obtained from the market.	
		Grade I.	Grade II.
Appearance	light colored	brown	dark brown
Sp. gr. at 15.5° C	0.9261	0.9253	0.9237
Saponification value	188	193	194
Iodine number	154	157	160
Acid number	0.55	64.25	106.48

The results of the analyses of lumbang oil quoted by Wilcox and Thompson and of those of Aguilar vary somewhat, but they all have the same characteristics of high iodine and saponification values.

The constants of Philippine lumbang oil are quite similar to those of tung and linseed oils. This is shown by the work of Richmond and Rosario, the results of which are recorded in Table 18. In view of this similarity, it is not surprising that lumbang oil has properties very similar to those of tung and linseed oils and that it may be used for like purposes.

TABLE 18.—*Constants of lumbang, tung and linseed oils.*

[Data from Richmond and Rosario.]

Constants.	Lumbang (Aleurites moluccana.)	Bagilumbang (Aleurites trisperma.)	Chinese wood or tung oil (Aleurites sp.)	Linseed oil.
Specific gravity at 15° C	0.925-0.927	0.9868	0.9425	0.9368
Acid value (milligrams of potash per one gram of oil)	2.115	2.150	4.547 4.568	3.18
Saponification value (milligrams of potash per one gram of oil)	193.5	200.3 200.5	189.3	186
Iodine value (Hanus)	150.2	158.5	155.7	179
Maumené value	100	86.2	105	103
Refractive index at 60° C	1.4648	1.483	1.5032	1.4687
Hehner value	95.54	95.79	94.32	94.43
Melting point	-12° C.	2°-4° C.	2° C.	
Solidifying point	-22° C.	-6.5° C.	-7.5° C.	-25° C.

Analyses of the oil cakes, which were obtained on a large scale by expelling the oil from the crushed kernels, are given in Table 19.

TABLE 19.—*Analyses of lumbang oil cake.*

Constituents.	Sample.	
	1.[a]	2.[b]
Oil	8.8	5.5
Moisture	10.00	10.25
Ash	8.28	----------
Protein	46.16	47.81
Fiber	1.47	----------
P_2O_5	4.39	3.68
K_2O	1.95	1.53
Mg & Ca	----------	7.19

[a] Lewkowitsch, Journal of the Society of Chemical Industry, Volume 20 (1901), page 909.
[b] Semler, H., Die Tropische Agrikultur, Volume 2, page 515.

Although the oil cake apparently has a high food value it cannot, according to Wilcox and Thompson, be used as cattle food because it has a poisonous effect upon stock. It is a matter of common knowledge that the kernels, either fresh or old, are strongly purgative. The cake left after the oil has been extracted from the kernel is used as a fertilizer, chiefly by the Chinese betel-pepper growers.

Lumbang has been very successfully grown by the Division of Investigation, Bureau of Forestry, at Los Baños. The planting of this species was begun by Forester H. M. Curran. Table 20 gives average rates of growth of large numbers of these trees. For the last few years the trees in the plantations have been rather crowded, and the best trees have made considerably faster rates of growth than the average indicated in the table. The smaller trees should be removed so as to leave more space for the larger ones. The trees which will be left permanently in the plantation have, therefore, shown a faster rate of growth than that given in the table.

TABLE 20.—*Growth of Aleurites moluccana (lumbang) in plantations at Los Baños, Laguna.*

Age.	Diameter.	Height.
Years.	*cm.*	*m.*
2	----------	3.58
3	4	4.72
4	8	7.28
5	10	8.13
6	12	10.32
8	15	12.40

Trees on the edge of the plantation have produced considerable quantities of nuts for several years, while those in the main stand have produced comparatively few. Some trees flowered and produced fruit when three years old.

Difficulty has been experienced in germinating the seeds of *Aleurites moluccana.* The seeds are very hard-shelled, and untreated seeds have been known to stay in a seed bed for as long as 38 to 150 days before germination. The most satisfactory method of treatment used was to place the seeds on the ground in a single layer and cover them with dried leaves or kogon grass (*Imperata exaltata*). The grass is then burned. Immediately after burning and while the seeds are still hot, they are thrown into cold water, which results in the cracking of the hard shells. The results obtained by this kind of treatment showed an average germination of more than 30 per cent. The seeds of lumbang are supposed to retain their vitality for a year or more, but we have very little certain knowledge on this point.

As the seeds of lumbang have very hard shells and germinate slowly, large quantities of them accumulate on the ground under trees. They can, apparently, lie in this condition for a long time without losing much, if any, of their oil content.

The yield of nuts per tree has not been determined accurately, and the common method of gathering the nuts makes such a determination difficult. Some people in Laguna, who engage in the business, estimate the yield from a tree at from 5,000 to 15,000 seeds a year. As the nuts average about 10 grams each, this would be 50 to 150 kilograms per tree. One man said that he had thirty trees in his plantation and that every year he obtained an average of 300 kilograms of husked seeds. This would be about 30 kilograms of unhusked nuts per tree. Aguilar informs us that he obtained from Cavite two sacks of nuts, each sack weighing about 25 kilograms and each of which, according to the collector, was obtained from a single tree. This estimate agrees rather closely with the one just mentioned. According to the above estimates a tree would yield from 5 to 30 kilograms of oil per year.

The fruits are allowed to fall and lie on the ground until that part of the fruit which surrounds the seed has decayed, after which the nuts are collected.

Aleurites moluccana is a large tree reaching a diameter of 80 to 150 centimeters. The younger parts and inflorescences are hairy. The leaves have long petioles. The blades are 10 to 20 centimeters long and are either entire or lobed. The fruit is ovoid, and 5 to 6 centimeters long. It contains one or two hard-shelled seeds. The seed is about 3 centimeters long and 2.5 centimeters broad. It has a hard, rough, ridged shell about 2.5 millimeters thick. This contains a white, oily, fleshy kernel consisting of a very thin embryo surrounded by a large endosperm. This is in turn covered by a thin, white, papery seed coat. This thin seed coat adheres firmly to both the shell and the kernel, so that the kernel is separated from the shell with difficulty.

This species is distributed from Luzon to Mindanao and Palawan, and recently has been planted in great numbers in Cebu.

ALEURITES TRISPERMA Blanco. (Fig. 46). BAGILUMBÁNG.

Local names: *Bagilumbáng, balukanád* (Laguna).; *banukalág, lumbang-banukalád, lumbang-gúbat* (Cavite); *balukanág* (Batangas); *lumbáng* (Oriental Negros, Camarines). Also reported from Rizal, Tayabas and Davao.

BAGILUMBÁNG OIL

As previously mentioned, oil extracted from the nuts of *Aleurites trisperma* has characteristics which are almost indistinguishable from those of Chinese wood oil or tung oil.

According to Heyne * *Aleurites cordata* R. Br., until recently and erroneously believed to be a source of wood oil, occurs in southern Japan. The constants of this oil are remarkably like those of bagilumbang oil from *Aleurites trisperma.*

The shells of *Aleurites trisperma* are much more easily cracked than those of *Aleurites moluccana.* Moreover, the kernel is not so difficult to separate from the shell because, when the nut is dry, the kernel shrinks somewhat and may be easily removed after the nuts have been cracked. Richmond and del Rosario † found that one kilo of whole nuts contained 357 grams of shells and 643 grams of kernels.

The oil from the nuts of *Aleurites trisperma* deteriorates when the nuts are stored. Moreover, according to Aguilar, the oil deteriorates also if not kept in an hermetically sealed container.

Aguilar says that the yield of oil by expression at 800 kilograms per square centimeter may reach as high as 56 per cent of the weight of the kernels. Oil prepared from fresh nuts is of very good quality and light amber in color. The constants of bagilumbang oil have been determined by Richmond and Ro-

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, (1913).

† Richmond, G. F. and Rosario, M. V. del, Commercial utilization of some Philippine oil-bearing seeds; preliminary paper. Philippine Journal of Science, Volume 2 (1907), pages 439 to 449.

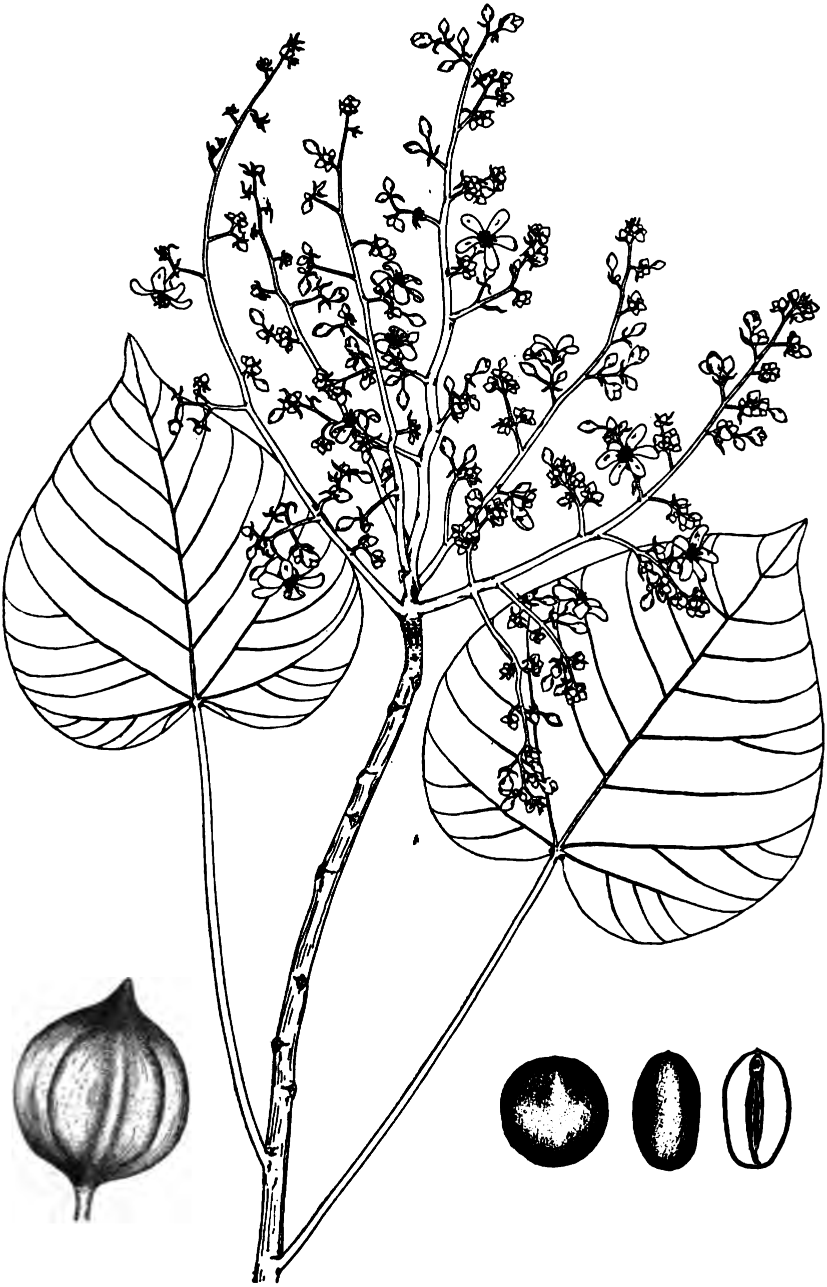

FIGURE 46. ALEURITES TRISPERMA (BAGILUMBANG), THE SOURCE OF BAGILUMBANG OIL. ×½.

sario. A few of these constants have also been determined by Aguilar. These results are recorded in Table 21. Bagilumbang oil, like lumbang, has high iodine and saponification values and its physical and chemical properties are generally satisfactory. However, when the bagilumbang nuts were kept about sixteen months, they underwent so great a change in the oil value that the yield by expression was reduced from 56 to 40 per cent of the weight of the kernel, and the oil was high in acid value and much darker in color than that obtained from the fresh nuts.

TABLE 21.—*Constants of bagilumbang oil.*

Constants.	Sample.	
	1.[a]	2.[b]
Specific gravity 15.0° C	0.9368	
Specific gravity 15.5° C		0.9362
Acid value (milligrams of potash per one gram of oil)	2.150	
Acid value (cc. O.1 N KOH)		2.22
Saponification value	200.5	191
Iodine value (Hanus)	158.5	166
Maumene value	86.2	
Refractive index (60° C)	1.483	
Hehner value	95.79	
Melting point	2°-4° C.	
Solidifying point	-6.5 C.	

[a] Richmond, G. F., and Rosario, M. V. del, Commercial utilization of some Philippine oil-bearing seeds: preliminary paper. Philippine Journal of Science, Volume 2 (1907), page 439.

[b] Aguilar, R. H., A comparison of linseed oil and lumbang oils as paint vehicles. Philippine Journal of Science, Volume 12 (1917), page 235.

According to Aguilar, the nuts of *Aleurites trisperma* may be crushed and finely ground in an oil mill and the oil extracted directly from the crushed nuts. However, he found that the oil thus obtained was dirty, highly contaminated with shell particles, dark colored, and had a relatively high acid value. Owing to the small amount of labor involved in shelling the nuts, it seems desirable to extract the oil from the kernels rather than from the whole nuts. It probably would be more profitable to cultivate *Aleurites trisperma* than *Aleurites moluccana,* as the nuts of the former are more easily shelled than those of the latter, and, moreover, bagilumbang oil resembles tung oil more closely than does lumbang oil.

However, *Aleurites trisperma* is not so abundant as *Aleurites moluccana* and consequently the supply of bagilumbang nuts cannot be depended upon until planted trees have begun to bear. The attention of manufacturers should, therefore, be directed for the present to the production of lumbang oil rather than bagilumbang. Although the extraction of oil from bagilumbang nuts alone might not be profitable with the present small supply, it would probably become so if carried on in connection with the extraction of lumbang oil.

The fertilizing value of the cake of *Aleurites trisperma* compares favorably with that of *Aleurites moluccana*, as will be seen from Table 22, taken from Aguilar.

TABLE 22.—*Fertilizing value of bagilumbang (Aleurites trisperma) cake.*

Constituents.	Cake from kernel.	Cake from crushed nuts.
	Per cent.	*Per cent.*
Moisture	7.67	9.45
Nitrogen (N_2)	6.20	2.99
Potash (K_2O)	1.79	0.90
Phosphorus (P_2O_5)	1.18	0.95

Planting experiments carried on by the Division of Investigation, Bureau of Forestry, at Los Baños showed a germination of 98 per cent, germination taking place in nineteen days. At the end of the first year the plants had an average height of 54 centimeters.

This species, like *Aleurites moluccana*, was hardy and grew rapidly. The average rates of growth of large numbers of trees are given in Table 23.

TABLE 23.—*Growth of Aleurites trisperma (bagilumbang) in plantations at Los Baños, Laguna.*

Age.	Diameter.	Height.
Years.	*cm.*	*m.*
2		1.84
3	5	3.15
5	7	5.08

Aleurites trisperma is a tree 10 to 15 meters or more in height. It does not have hairs except on the inflorescences. The fruit is 5 to 6 centimeters in diameter, somewhat rounded and angled, opens later along the angles, and usually has three cells, each of which contains a single seed. The seed is somewhat circular, flattened, rather smooth, but with numerous small ridges. It has a hard, brittle shell about 0.5 millimeter thick. This contains a white, oily, fleshy kernel consisting of a very thin embryo surrounded by a large endosperm. This in turn is covered by a thin, white, papery seed coat. When dry the kernel with the thin seed coat shrinks slightly away from the shell, so that the shell and kernel are easily separated. The kernels, when fresh, have a pleasant nutty flavor, but leave a burning sensation in mouth, throat, esophagus and stomach; even a part of one nut may cause either violent vomiting within half an hour or else a terrific diarrhœa, beginning within a few hours after eating and lasting from 12 to 24 hours.

This species is a native of the Philippines and is not found outside of the Archipelago. It is apparently not abundant, but quantities sufficient for extensive planting can be secured every year.

Genus CROTON

CROTON TIGLIUM L. (Fig. 47). CROTON OIL PLANT.

Local names: *Gasi* (Zambales); *kamaisá* (Rizal, Mindoro); *kamausá* (Bulacan); *kaslá* (Balabac Island); *makaslá* (Busuanga Island); *malapi* (Basilan); *marachuíte* (Ilocos Sur); *saligau* (Union, Benguet, Cagayan); *túba* (Negros, Camarines, Sorsogon, Samar, Cagayan, Marinduque, Leyte, Rizal, Mindoro, Tayabas); *tubang-makaisá* (Tayabas, Camarines); *tuba-túba* (Negros, Camarines); *tublí* (Lanao).

CROTON OIL

The seeds of this plant yield the croton oil of commerce, which is used chiefly in pharmaceutical preparations. The fruits or crushed leaves of this species are used in poisoning fishes. When the seeds are used for this purpose, they are pulverized and put in sacks which are placed in ponds or rivers.

According to Lewkowitsch,* the seeds of *Croton tiglium* yield 53 to 56 per cent of croton oil. The oil has a yellow, orange, or brown color, according to its age. It has a nauseous odor, a burning taste, and acts as a very powerful purgative. It dissolves in petroleum ether in all proportions, differing in this respect from castor oil. It has the following constants (Lewkowitsch):

Specific gravity (15°)	0.9437
Solidifying point	—7°
Saponification value (Mgrms KOH)	192.9–215.6
Iodine value	101.7–109.1
Reichert-Meissl value (CC.1/10 KOH)	12.1–13.56
Refractive index (26°)	1.4781
Oleo-refractometer (22°)	+35°
Butyro-refractometer (27°)	68°–77.5°

Croton tiglium is a shrub or very small tree. The leaves are alternate, usually somewhat rounded at the base, pointed at the tip, with toothed margins, and from 7 to 12 centimeters in length.

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* Lewkowitsch, J., Oils, fats, and waxes (1915).

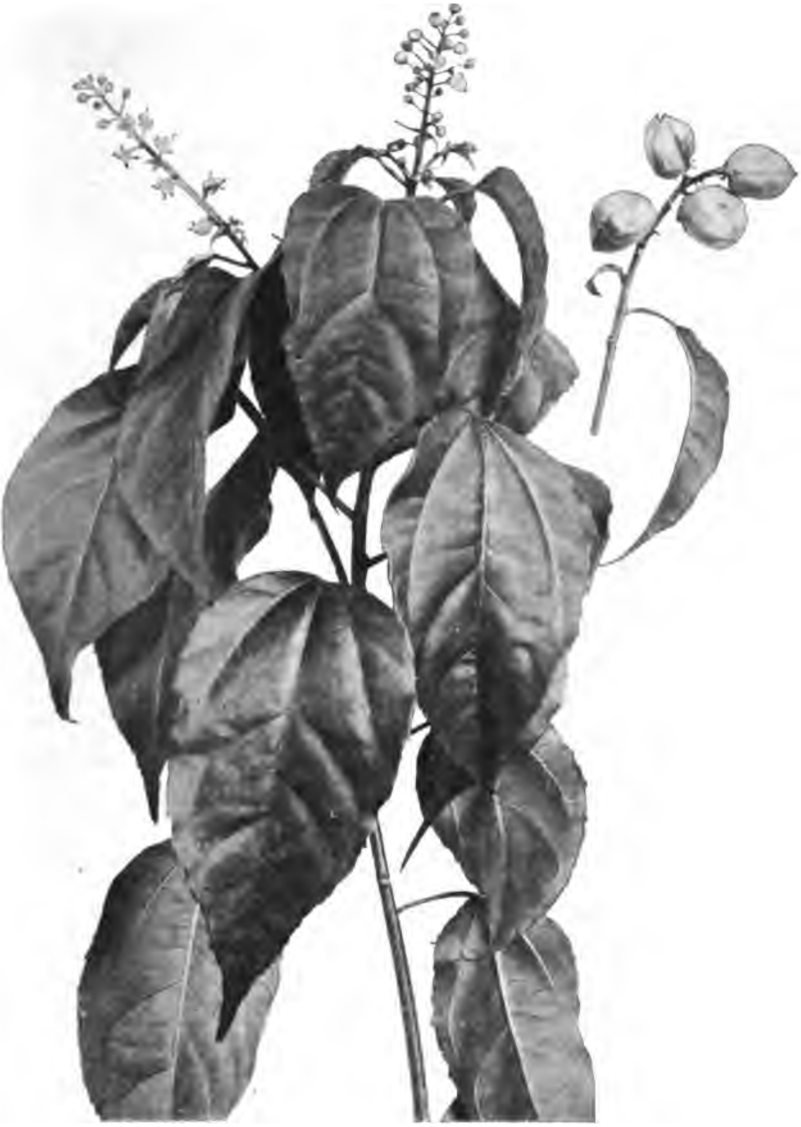

FIGURE 47. CROTON TIGLIUM, THE SOURCE OF CROTON OIL.

The flowers are small and inconspicuous. The seeds are borne in capsules which are usually three-angled and from 1.5 to 2 centimeters in length.

This species is found wild in the Philippines from northern Luzon to southern Mindanao. It is also cultivated to a limited extent.

Genus JATROPHA

JATROPHA CURCAS L. (Fig. 48). **Túbang-bákod or Physic nut.**

Local names: *Galumbáng* (Pampanga); *kirisól* (Bulacan); *takumbáu* (Zambales); *tagumbáu* (Ilocos Sur, Pangasinan, Bontoc); *tañgan-táñgan* (Bataan, Manila); *tañgantáñgan-túba* (Bulacan); *tau-uá* (Ilocos Sur); *taua-tauá* (Abra); *túba* (Rizal, Manila, Camarines, Mindoro); *tuba-túba* (Leyte); *túbang-bákod* (Laguna, Rizal).

PHYSIC-NUT OIL

The seeds of this species furnish an oil used as an emetic and purgative. The oil has been used for illuminating purposes in some parts of the Philippines. It is known in commerce as curcas oil. According to Richmond and Del Rosario * this oil belongs to the class of semidrying oils and is employed in the manufacture of soaps and candles and also as an illuminant and lubricant, but because of its drying properties it is not well adapted for the last-mentioned purpose. In India it is used as a purgative. A single fresh seed, eaten raw, may cause both vomiting and severe diarrhoea.

Lewkowitsch † states that the fresh oil has a pale color, but becomes yellow with a reddish tint on exposure to the air. Its unpleasant odor is characteristic, and may serve to distinguish curcas oil from other oils; it is further characterized by its strong purgative properties, which are much more pronounced than those of castor oil. The constants of curcas oil are given in Table 24.

TABLE 24.—*Constants of physic nut oil.*

Constants.	(a)	(b)	(c)
Acid value	8.5	19	11
Saponification value		192.4	192.6
Unsaponifiable value	0.5		
Acetyl value	8.4		
Reichert-Meissl value		0.5	0.5
Iodine value		89	88

[a] Lewkowitsch, J. Oils, fats, and waxes.

[b] and [c] Heyne, K., De Nuttige Planten van Nederlandsch-Indië (1913).

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* Richmond, G. F., and Rosario, M. V. del, Commercial utilization of some Philippine oil-bearing seeds; preliminary paper. Philippine Journal of Science, Section A, Volume 2 (1907), page 446.

† Lewkowitsch, J., Oils, fats, and waxes (1915).

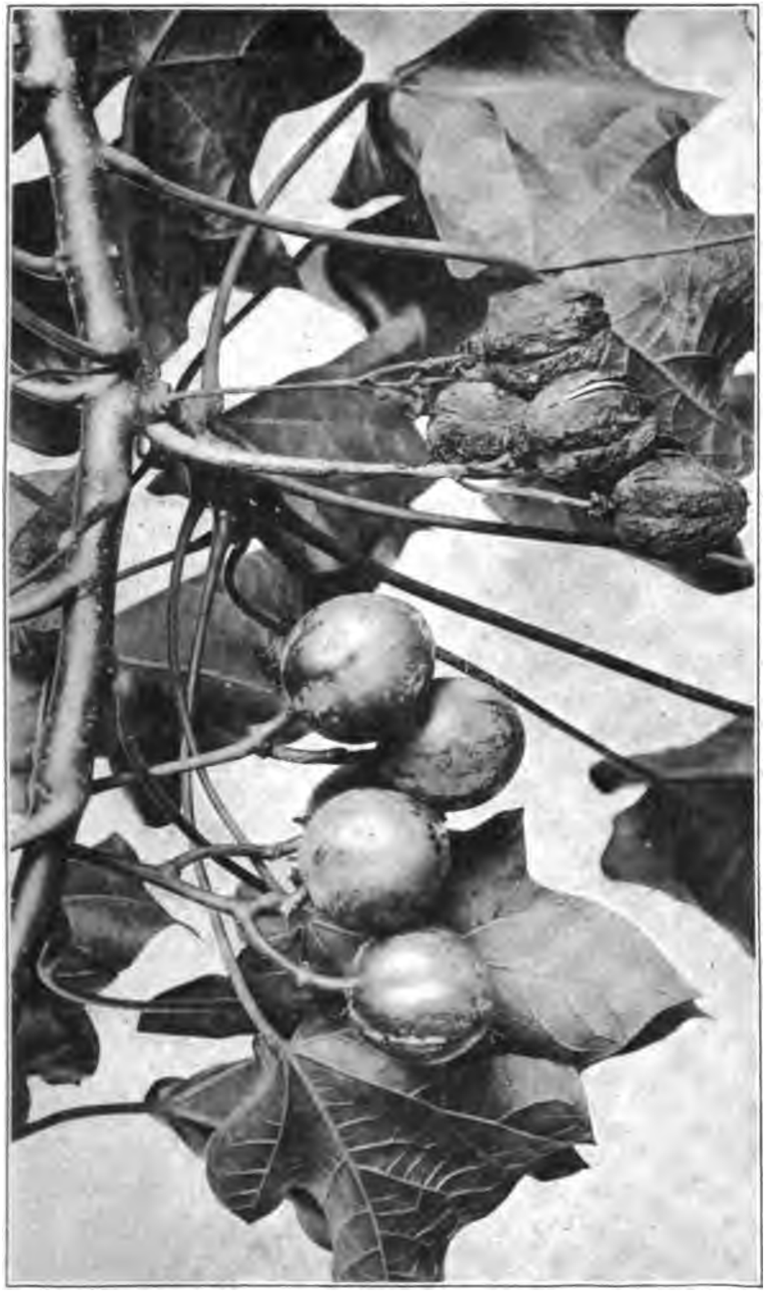

FIGURE 48. JATROPHA CURCAS (TÚBANG-BAKOD), THE SOURCE OF PHYSIC-NUT OIL.

Richmond and Rosario say that the physic nuts they examined gave 45 per cent of hulls and 55 per cent of kernels; the latter yielded by extraction with chloroform 63.05 per cent of oil, which corresponds to 34.65 per cent calculated on the basis of whole seeds.

Jatropha curcas is an erect shrub or small tree 2 to 5 meters in height. The leaves are entire, angular or somewhat 3- to 5-lobed, and 10 to 18 centimeters long; the apex is pointed, the base heart-shaped, the petiole long. The flowers are greenish white, and 7 to 8 millimeters in diameter. The capsule is rounded, at first fleshy, but later becoming dry, and composed of 2 or 3 one-seeded divisions which are 3 or 4 centimeters long.

This species is a native of tropical America, but is now thoroughly naturalized and widely distributed throughout the Philippines, being most commonly cultivated in towns as a hedge-plant. Hence the name tubang-bakod, *túba* being a name given to many plants of this family used for poisoning fish and *bákod* the Tagalog word for hedge or fence.

JATROPHA MULTIFIDA L. MANÁ.

Local name: *Maná* (Spanish-Filipino).

MANÁ OIL

According to Heyne [*] the seeds are poisonous and contain about 30 per cent of oil, which is apparently very similar to that of *Jatropha curcas*. It is used in Java more for illuminating purposes than as a purgative.

Jatropha multifida is a shrub 2 or 3 meters in height. The petioles are as long as the leaves. The leaves are alternate, 15 to 30 centimeters long and divided nearly to the base into about ten rather narrow lobes, which are in turn frequently lobed. The flowers are red and 5 to 6 millimeters long. The capsule is somewhat three-angled and about 2 centimeters long.

This species is occasionally cultivated in the Philippines and is distributed from Luzon to Mindanao.

Genus MALLOTUS

MALLOTUS PHILIPPINENSIS Muell. Arg. BANÁTO.

BANÁTO OIL

A description and the local names of this species are given in the section on dyes.

According to Watt [†] the seeds yield 5.83 per cent of a bland oil. It is used medicinally by the people of India and many writers recommend it as worthy of investigation.*

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[*] Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 3 (1917), page 100.

[†] Watt, G., The commercial products of India (1908), page 757.

Hefter † says that the yield of oil is 20 to 24 per cent.

Genus RICINUS

RICINUS COMMUNIS L. (Fig. 49). TAÑGAN-TÁÑGAN or CASTOR-OIL PLANT.

Local names: *Katana* (Batanes Islands); *lansína* (Batangas); *talampúnai* (Laguna); *tañgantáñgan* (Ilocos Norte and Sur, Abra, Cagayan, Pangasinan, Pampanga, Zambales, Bataan, Bulacan, Rizal, Manila, Laguna, Tayabas, Camarines, Albay, Sorsogon, Masbate, Capiz, Misamis, Cuyo Islands); *tau-ua-tau-uá* (Ilocos Norte, Bontoc, Pangasinan).

CASTOR OIL

This plant, the source of the castor oil of commerce, grows wild in all parts of the Philippines, but the seeds are said to be very poor in oil. According to the Bureau of Agriculture, only imported seeds of improved varieties should be planted.

Castor oil is used medicinally as a purgative. It is also used in the manufacture of Turkey-red oils and in making soap. It is employed as a lubricant, as a preservative of leather, and for other purposes. Recently the demand for castor oil has increased owing to the fact that it is used as a lubricant for airplane engines.

Bottler and Sabin ‡ state:

> Castor-oil is used as an ingredient for "artificial skin" varnishes, such as one composed of shellac 1 part, alcohol 3 parts, castor-oil ⅛ part; or another, 8 parts collodion to 1 part castor-oil; it is also used in retouching-varnishes and negative varnishes in photography.
>
> To give elasticity to spirit varnishes, it is thinned with alcohol to the consistency of the varnish, and added to it.

Castor oil is colorless or slightly greenish. Commercially it is manufactured by expression or extraction. The best quality, which is used for medicinal purposes, can only be prepared by expression in the cold, as the poisonous alkaloid, ricine, does not pass into the oil under these conditions. The expressed oil cake contains the poisonous alkaloid and is unfit for use as cattle food. It is serviceable, however, as an excellent fertilizer.

Scherubel § discusses the cultivation, harvest, and extraction

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[*] Watt, G., Dictionary of the economic products of India, Volume 5 (1891), page 122.

[†] Hefter, G., Technologie der Fette und Öle (1908).

[‡] Bottler, M., and Sabin, A. H., German and American varnish making, page 48.

[§] Scherubel, E., Journal of the Department of Agriculture, Victoria, Volume 16 (1918), page 505.

of oil from the castor-oil seeds and states that seeds from two varieties grown wild in Australia contained 47 to 49 per cent of oil. This yield is somewhat less than that obtained from Calcutta and Java seeds, which give about 53 per cent of oil.

The process of refining castor oil consists largely in removing albumen by steaming the oil. The albumen and part of the enzyme which has passed into the oil are thus coagulated and removed by filtering. Castor oil keeps very well when refined properly and does not easily become rancid. The percentage of free fatty acids does not increase considerably on standing. According to Lewkowitsch * a sample exposed to the athmosphere for four years contained only 1 per cent of free fatty acids.

Castor oil has the following constants (Lewkowitsch):

Specific gravity (15.5°), 0.9591.
Solidifying point –10° to –12°.
Saponification value (Mgrms KOH) 176.7 to 186.6.
Iodine value 81.4 to 90.6.
Reichert-Meissl value (C.C.1/10 norm. KOH) 1.1.
Acetyl value 149.9 to 150.5.
Maumené test 46° to 47°.
Refractive index (15°) 1.4795 to 1.4803.
Oleo-refractometer (22°) 37 to 46.
Butyro-refractometer (25°) 78°.
Viscosity (Redwood's viscosimeter) 1160 to 1190.

As shown by the figures above, the acetyl value is unusually high. Mitchell † states that castor oil has an acetyl value of about 150 and emphasizes the fact that other oils and fats have acetyl values ranging from about 2 (coconut oil) to 15 (cottonseed oil) and 19 (croton oil).

According to Richmond and Rosario ‡ castor oil could be manufactured in a coconut-oil mill and, if the plant were cultivated on a sufficient scale, there would be a possibility of the commercial production of this oil for lubricating and illuminating purposes. It could probably be sold as cheaply as coconut oil, which is now used extensively in food products.

Ricinus communis is a coarse, erect, somewhat woody bush about 1 to 4 meters high. The leaves are smooth, alternate, 20 to 60 centimeters in diameter and palmately divided, with pointed lobes. The leaves and stems are green or purplish. The fruit

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* Lewkowitsch, J., oils, fats, and waxes, (1915).

† Mitchell, C. A., Edible oils and fats, (1918).

‡ Richmond, G. F., and Rosario, M. V. del, Commercial utilization of some Philippine oil-bearing seeds: preliminary paper. Philippine Journal of Science, Section A, Volume 2 (1907), page 448.

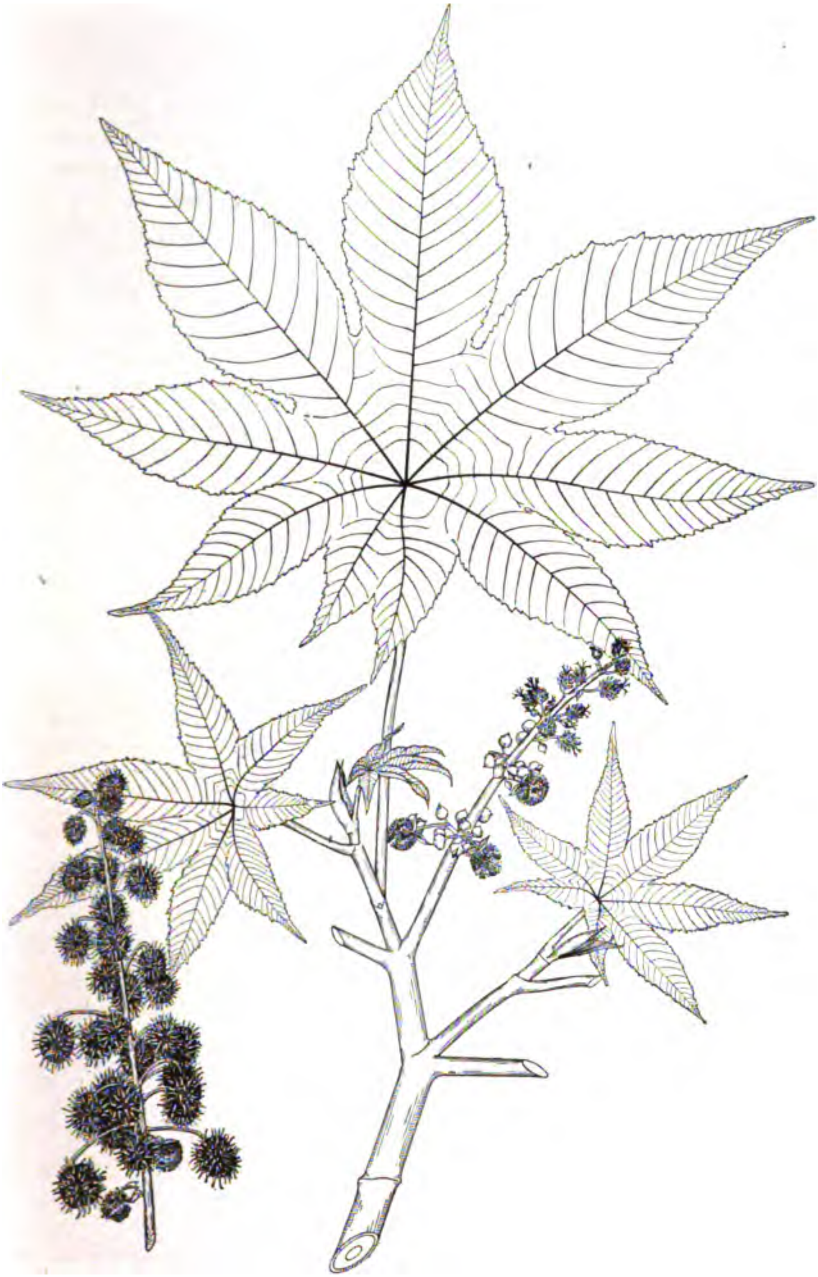

FIGURE 49. RICINUS COMMUNIS (TAÑGAN-TAÑGAN), THE SOURCE OF CASTOR OIL. ×½.

is an ovoid capsule, 1 to 1.5 centimeters long, and covered with soft, spine-like processes.

Family ANACARDIACEAE

Genus ANACARDIUM

ANACARDIUM OCCIDENTALE L. KASÚI or CASHEW NUT.

Local names: *Balúbad* or *balúbar* (Bataan, Pampanga, Bulacan); *balúbat* (Bataan, Mindoro); *batúban* (Bataan); *balúbog* (Bulacan); *kachúi* (Palawan); *kasói* or *kasúi* (Isabela, Ilocos Norte and Sur, Abra, Tarlac, Bataan, Zambales, Manila, Rizal, Laguna, Batangas, Camarines, Mindoro, Capiz, Marinduque, Palawan, Misamis, Cuyo Islands, Zamboanga); *kosíng* (Amburayan); *sambalduke* (Pangasinan).

CASHEW-NUT OIL

The roasted kernels are often used to make a very savory nut candy, and also, according to Richmond and Rosario,* for the adulteration of chocolate. They say that the expressed kernels yield a sweet, yellowish oil.

Lewkowitsch † states that the yield of oil from the kernels is 47.2 per cent and that the oil has the following constants:

Saponification value	195
Iodine value	84
Refractive index (20°)	1.4702

Watt ‡ says that:

> * * * Two oils are obtainable from this plant: (1) a light-yellow from the pressed kernels, of which the finest quality is equal to almond oil; and (2) "Cardole," obtained from the shell of the nut—an acrid and powerful fluid efficacious for preserving carved wood, books, etc., against white ants. * * *

Watt also mentions that the bark yields a gum which is obnoxious to insects.

Anacardium occidentale is a small tree with a trunk which is usually small and crooked. It has a large, yellow, pear-shaped fruit, with a kidney-shaped seed attached to one end. Both the fruit and seed are edible, the fruit raw and the kernels raw or roasted.

This species, introduced at an early date from America, is widely distributed in the Philippines. It is cultivated in towns and on farms, and runs wild in old clearings.

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* Richmond, G. F., and Rosario, M. V. del, Commercial utilization of some Philippine oil-bearing seeds; preliminary paper. Philippine Journal of Science, Section A, Volume 2 (1907), page 445.

† Lewkowitsch, J., Oils, fats, and waxes (1915).

‡ Watt, George, The commercial products of India (1908).

Family CELASTRACEAE

Genus CELASTRUS

CELASTRUS PANICULATA Willd.

CELASTRUS PANICULATA OIL

According to Watt: *

The seeds yield by expression a deep scarlet or yellow oil, used medicinally. The oil deposits a quantity of fat after it has been kept a short time. Its odour is pungent and acrid, and treated with sulphuric acid it turns of a dark bistre colour. It is much admired as an external application along with a poultice of the crushed seeds. It is also burnt in lamps, and employed in certain religious ceremonies. The seeds submitted to destructive distillation yield the "Oleum Nigrum," an empyreumatic black oily fluid employed medicinally in the treatment of *beri-beri* (*Cooke*). According to Dr. Dymock, the seeds are distilled along with benzoin, cloves, nutmegs, and mace. This oil is manufactured in the Northern Circars, the best in Vizagapatam and Ellore, where it is sold in small blue or black bottles, each containing about ¼ oz., at prices from 12 annas to one rupee a bottle.

Lewkowitsch † states that:

The seeds from the shrub *Celastrus paniculatus* yield a dark-red pungent oil from which "stearine" separates on standing. In Ceylon this oil is known as "Duhudu oil," and serves as a nerve stimulant; it is also used there for external application to sores.

Celastrus paniculata is a large, woody vine. The leaves are alternate, somewhat oval shaped, pointed at the tip, rounded or slightly pointed at the base, with toothed margins, and 5 to 12 centimeters long. The inflorescences are 7 to 18 centimeters long. The flowers are numerous, greenish or greenish white, and about .5 millimeter in diameter. The fruit is an ovoid or somewhat rounded, yellow capsule which is 7 to 9 centimeters long and three-celled.

This species is distributed from northern Luzon to Mindanao and Palawan.

Family SAPINDACEAE

Genus GANOPHYLLUM

GANOPHYLLUM FALCATUM Blume. (Fig. 50). ARÁN͠GEN.

Local names: *Arán͠gen* (Iloko in Union, Pangasinan); *bagusalai* (Misamis); *gogong-lán͠gil* (Cavite); *gogolín͠gin* (Pampanga); *gúgo* (Tablas Island); *hálas* (Capiz); *malatumbága* (Bataan); *odó* (Mindoro); *palumpúng, pararan* (Davao); *sáleng* (Bontoc); *tugábi* (Tayabas).

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* Watt, G., A dictionary of the economic products of India, Volume 2 (1889), page 238.

† Lewkowitsch, J., Oils, fats, and waxes, Volume 2 (1915), page 338.

ARÁÑGEN OIL

The seeds of this species yield a solid fat used for illumination. The people of the hills back of San Fernando, La Union, chiefly the Igorotes, have extracted this product for many years. The seeds are crushed and then boiled, when the oil floats on the surface. Wells,* who examined this product, says that even with potash it makes a good hard soap.

Ganophyllum falcatum is a tree reaching a height of about 25 meters and a diameter of about 70 centimeters. The leaves are alternate, 20 to 35 centimeters long, and pinnate with alternate leaflets which are inequilateral, pointed at the tip, oblique at the base, and from 5 to 12 centimeters in length. The flowers are small, yellowish, and occur in large numbers on compound flowering shoots. The fruits are about 1.5 centimeters in length, pointed at the tip, rounded at the base, and contain a single seed. The wood is hard and heavy, of fine texture, yellowish white, apparently durable, and is used locally for posts and other structural parts of houses.

This species is distributed from northern Luzon to Mindanao.

Genus NEPHELIUM

NEPHELIUM LAPPACEUM L. USÁU OR RAMBUTÁN.

RAMBUTÁN TALLOW

A description, figure, and the local names of this species are given in the bulletin on edible plants.

Hefter † states that the seeds of *Nephelium lappaceum* yield 40 to 48 per cent of rambután tallow.

According to Baczewski ‡ this tallow has the following constants:

Specific gravity	0.9236
Solidifying point	38°-39°
Melting point	42°-46°
Saponification value	193.8
Iodine value	39.4

The insoluble fatty acids of this tallow contain 45.5 per cent of oleic acid.

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* Wells, A. H., Chief, Division of Organic Chemistry, Bureau of Science, Manila.

† Hefter, G., Technologie der Fette und Öle, Volume 2 (1908), page 652.

‡ Baczewski, M., Chemische untersuchung der Samen von Nephelium lappaceum und des darin enthaltenen fettes. Monatshefte für Chemie, Volume 16 (1895), page 866.

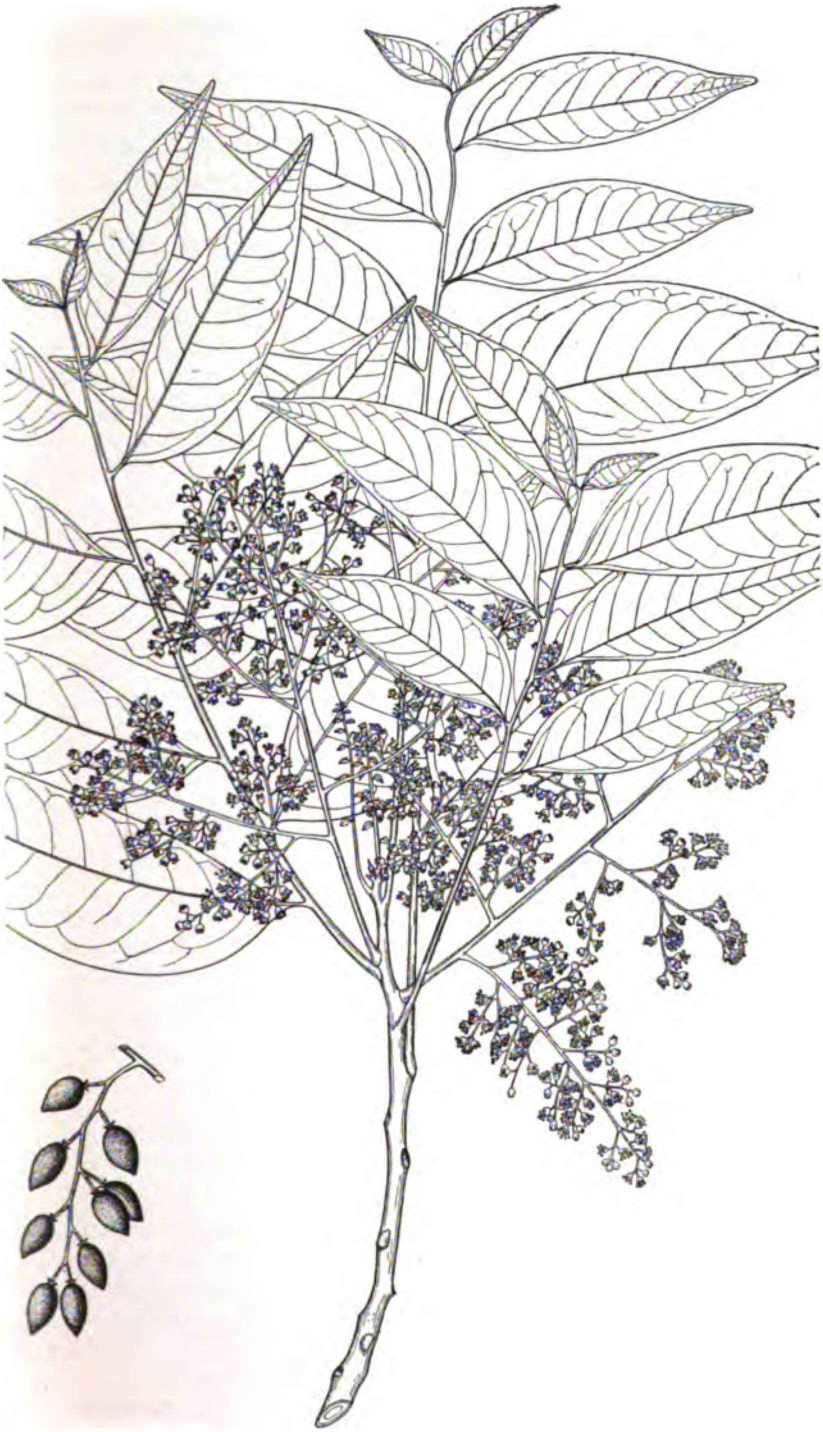

FIGURE 50. GANOPHYLLUM FALCATUM (ARAÑGEN). ×½.

NEPHELIUM MUTABILE Blanco. BULÁLA.

Local names: *Alpái* (Laguna); *bakaláu* (Pangasinan); *balimbíñgan* (Lanao); *bulála* (Camarines, Tayabas, Laguna, Rizal); *kakao-kakao* (Surigao); *karayo* (Mindoro); *laguan* (Tayabas); *malamputían* (Samar); *maráñgis* (Cagayan); *pangyáu* (Rizal).

BULÁLA OIL

Heyne * reports that according to Greshoff the seeds contain 29.2 per cent of fat melting at 34° C. He says that it was formerly used as a lamp oil.

Nephelium mutabile is a tree reaching a height of about 25 meters and a diameter of 45 centimeters. The leaves are alternate and compound, with rather large, smooth, alternate leaflets, which are pointed at both ends. The flowers are small and occur in considerable numbers on simple or compound inflorescences. The fruits are red, about 4 centimeters in length, and completely covered with numerous, rather soft projections. The flesh is white, abundant, juicy, and of very good flavor. It surrounds a single, rather large seed.

This species is distributed from northern Luzon to southern Mindanao and is very common in Luzon.

Family BOMBACACEAE

Genus CEIBA

CEIBA PENTANDRA Gaertn. (Fig. 51). COTTON TREE or KÁPOK.

Local names: *Balios* (Bulacan); *basangláí* (Ilocos Sur, Abra); *bobói, bubúi* (Bulacan, Bataan, Cavite, Batangas, Rizal, Laguna, Tayabas, Mindoro); *boibói* (Capiz); *búlak* (Abra, Zambales, Pampanga, Bulacan, Cavite); *búlak-dondól* (Cebu); *búlak-kastíla* (Pampanga); *búlak-sino* (Bulacan, Bataan, Cavite, Batangas, Rizal, Laguna, Tayabas, Mindoro); *dogdól* (Cebu); *doldól* (Leyte, Samar, Iloilo, Antique, Capiz, Bohol, Cebu, Cuyo Islands); *dondól* (Cebu); *gápas* (Misamis); *kápah* (Zambales); *kápak* (Bulacan, Rizal, Bohol); *kápas* (Ilocos Norte and Sur, Zambales); *kápas-sangláí* (Ilocos Norte and Sur, Abra); *kápok* or *kapók* (Tarlac, Sorsogon, Masbate, Davao and other parts of Mindanao, Basilan, Sulu group); *kapös* (Pangasinan); *kasangláí* (Pangasinan); *káyo* (Camarines, Albay, Sorsogon, Samar, Leyte, Capiz, Antique, Iloilo, Cebu, Bohol); *sangláí* (Abra).

KÁPOK OIL

An oil resembling cotton-seed oil is extracted from the kapok seeds. It has a greenish-yellow color and a taste and odor which is not unpleasant. The oil is used for the manufacture of soap and as a substitute for cotton-seed oil. Concerning the use of

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 3 (1917), page 162.

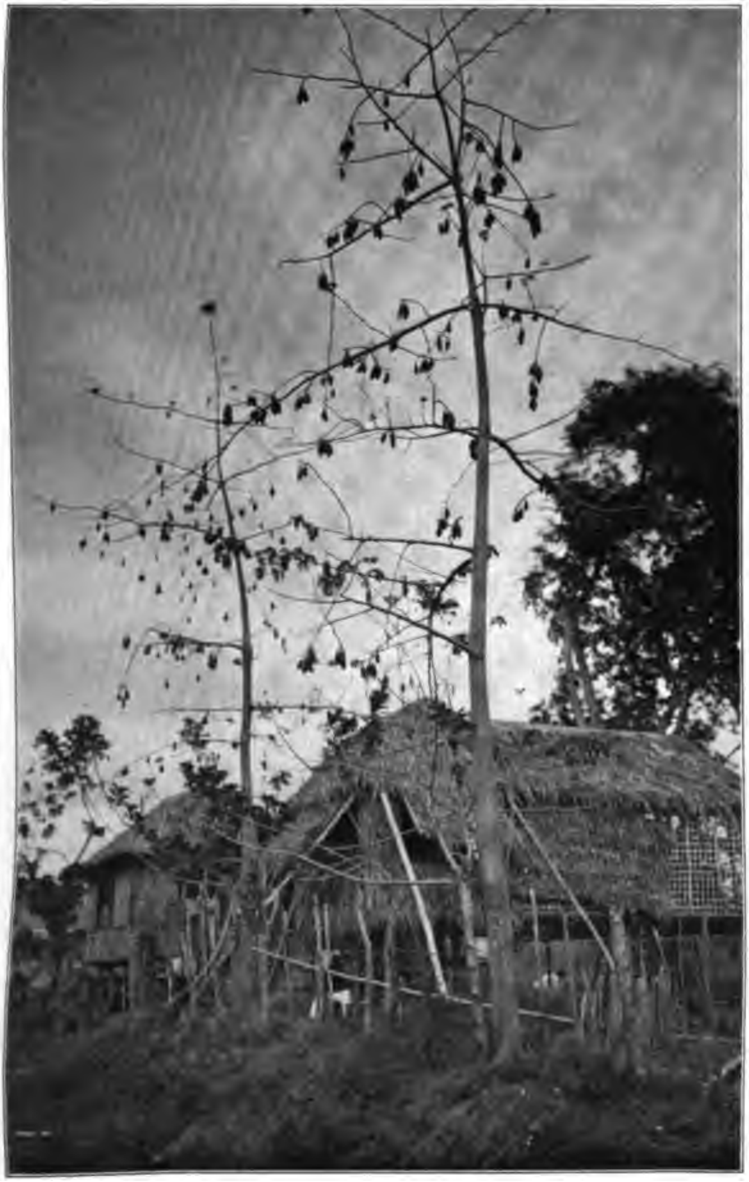

FIGURE 51. CEIBA PENTANDRA (KAPOK), THE SOURCE OF KAPOK OIL.

kapok oil in Marseilles for soap making, the American Perfumer[*] states:

> * * * The seed is treated in two mills, both of which are chiefly devoted to the crushing of other seeds. Only one pressing is the rule, although in some cases hot water is poured over the residue, which is then pressed again. The oil is then filtered, but it requires neither bleaching, deodorizing, nor any other treatment. In the Marseilles mills the average yield in oil from this seed is about 15 per cent. The price of the oil follows closely that of industrial peanut oil. It takes about 16½ pounds of kapok to make a gallon of oil.

Lewkowitsch[†] says the seeds have the following average composition:

	Per cent.
Oil	24.20
Water	11.85
Ash	5.22
Crude fiber	23.91
Albuminoids	18.92
Carbohydrates, etc	15.90

Experiments carried out by the Philippine Bureau of Agriculture indicate that the fresh cake is valuable as stock food. According to Richmond and del Rosario[‡] the product much resembles ground linseed in food value.

Kapok oil has the following constants (Lewkowitsch):[†]

Specific gravity at 15° C	0.9235
Solidifying point	29.6°
Saponification value (Mgrms KOH)	181–205
Iodine value	117.9
Maumené test	95
Refractive index	51.3

The oil consists of a mixture of fatty acids, about 70 per cent of which is liquid, while 30 per cent is palmitic acid, which is a solid.

Ceiba pentandra is a slender tree 15 meters or less in height. The trunk is armed with large, scattered spines. The branches are borne in horizontal whorls which are very characteristic. The capsules are about 15 centimeters long, and 5 centimeters thick. They contain black seeds imbedded in fine, silky hairs.

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[*] The American Perfumer, Volume 10 (1915–1916), page 298.

[†] Lewkowitsch, J., Oils, fats, and waxes (1915).

[‡] Richmond, G. F. and Rosario, M. V. del, Commercial utilization of some Philippine oil-bearing seeds: preliminary paper. Philippine Journal of Science, Volume 2 (1907), page 445.

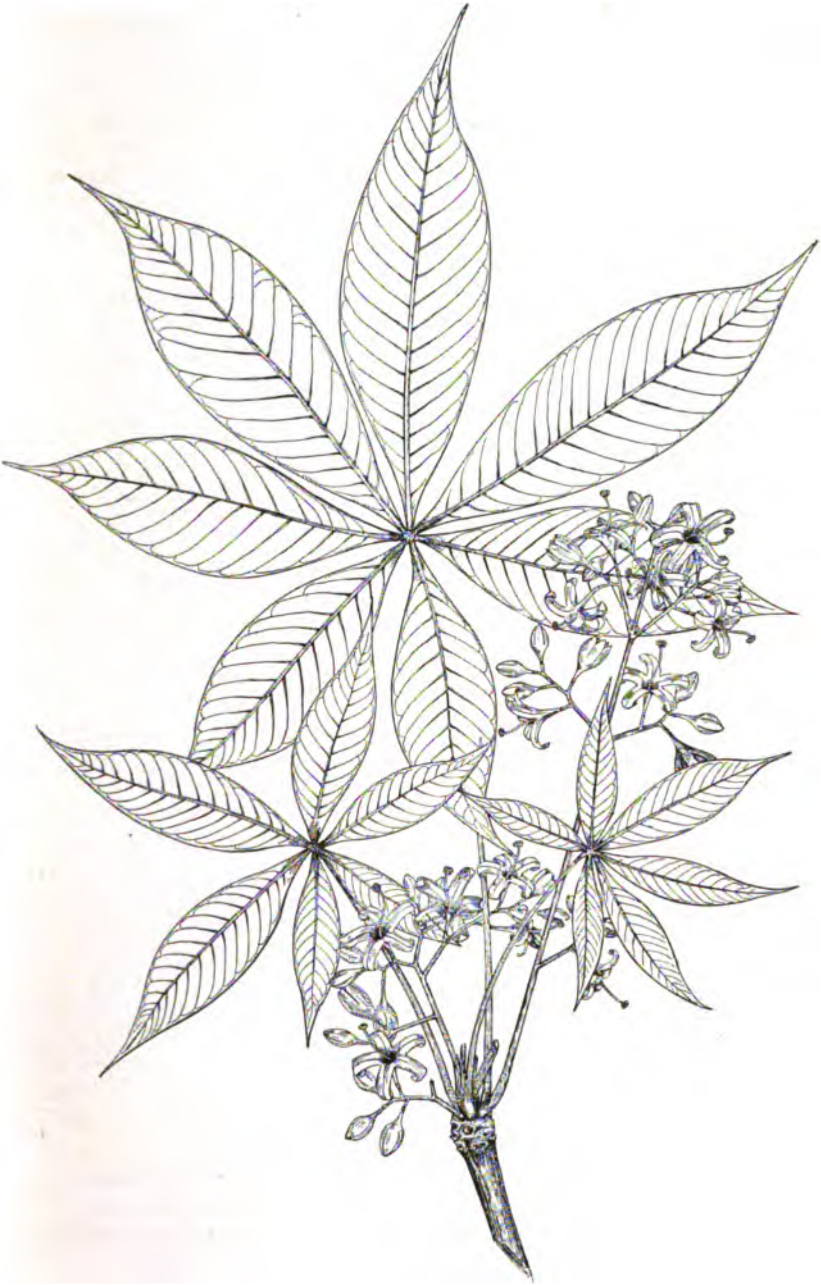

FIGURE 52. STERCULIA FOETIDA (KALUMPANG), THE SOURCE OF KALUMPANG OIL. ×½.

The fibers surrounding the seeds are soft, elastic, and immune to moths, and therefore very suitable for stuffing pillows, mattresses, etc., for which purposes they are extensively employed.

This species is commonly cultivated, particularly along the highways and in towns, in all parts of the Philippines.

Family STERCULIACEAE

Genus STERCULIA

STERCULIA FOETIDA L. (Figs. 52, 53). KALUMPÁNG.

Local names: *Bañgár* (Abra); *bañgát, bubúr* (Ilocos Sur); *bobóg* (Iloilo, Palawan); *buñgóg* (Cagayan); *kalumpáng* (Nueva Ecija, Tayabas, Pampanga, Rizal, Bataan, Manila, Laguna, Camarines, Iloilo, Mindoro, Palawan, Cotabato, Apo Island); *kurumpáng* (Davao).

KALUMPÁNG OIL

The fruits of this species and of several others of the genus contain a number of peanut-like, oily kernels. They are more or less laxative when eaten raw. An oil extracted from them is used locally for illuminating purposes. In some parts of the Islands the oil mixed with white earth is utilized as a paint. The oil is a bland, sweet, yellow oil, having a rather high melting point. Brill and Agcaoili * analyzed the dry, shelled seeds and determined the chemical constants of the oil obtained from them. The results are given in Tables 25 and 26. These tables also include the results obtained by Bolton and Jesson.†

TABLE 25.—*Composition of dry, shelled, kalumpang seeds.*

Constituents.	Analysis by Bureau of Science.	Analysis by Bolton and Jesson.
	Per cent.	*Per cent.*
Fat (by extraction of dry seeds)	51.78	52.0
Protein (N x 6.25)	21.61	----------
Starch	12.10	----------
Sugars	5.00	----------
Cellulose, etc. (by difference)	5.51	----------
Ash	3.90	----------

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* Brill, H. C., and Agcaoili, F., Philippine oil-bearing seeds and their properties: II. Philippine Journal of Science, Section A, Volume 10 (1915), page 108.

† Analyst, Volume 40 (1915), page 3.

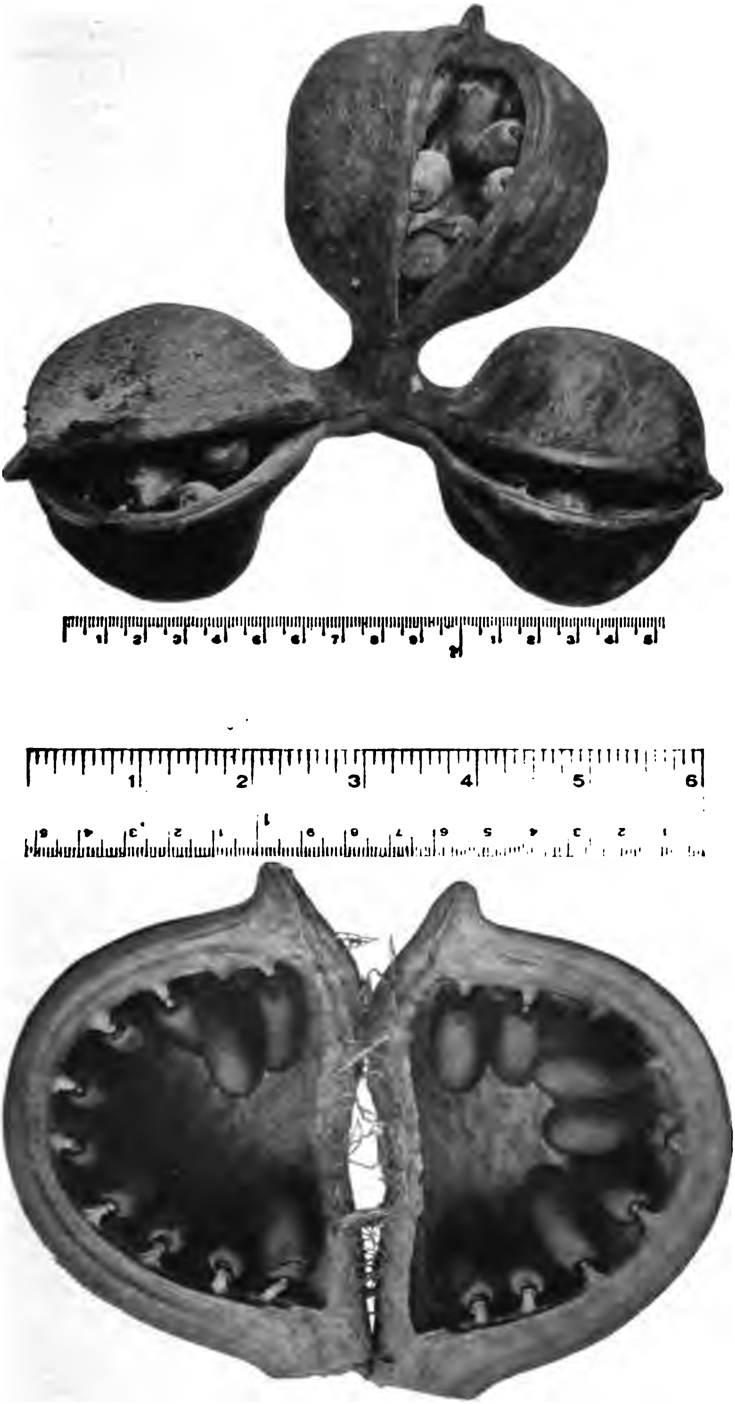

FIGURE 53. FRUITS OF STERCULIA FOETIDA (KALUMPANG), THE SOURCE OF KALUMPANG OIL.

TABLE 26.—*Chemical constants of kalumpang oil.*

Constants.	Analysis by	
	Bureau of Science.	Bolton and Jesson.
Specific gravity at 30°C	0.9254	....
Butyro refractometer reading at 40°C	63.64	....
Iodine value (Hanus)	76.04	75.8
Reichert-Meissl value	2.10	....
Saponification number	212.01	193.8
Free fatty acids (oleic) per cent	0.45	1.0
Acid value cc. N/10 KOH	0.30	....

According to Professor DuMez:[*]

> The oil appears to resemble olive oil very much in its physiological action. Administered to dogs in doses of 1.5 to 3 cubic centimeters per kilogram body weight, it acts as a mild laxative. It is nontoxic and has no irritating action. It can be used in the same manner as olive oil and should be especially useful for culinary purposes.

Sterculia foetida is a spreading tree reaching a height of 20 meters or more. The leaves are crowded at the ends of the branches. They are compound, having seven to nine leaflets borne in a whorl at the end of the petiole. The leaflets are 12 to 18 centimeters long. The flowers are rank-smelling, dull yellowish or purplish, and 2 to 2.5 centimeters in diameter. The fruit is large, woody, red, nearly smooth, ovoid, and about 10 centimeters long. It contains 10 to 15 seeds, which are about 2 centimeters long.

The wood of *Sterculia foetida* is used for cheap and temporary construction, box-lumber, etc. It is rarely cut for lumber except occasionally by larger operators, with the cheapest grade of miscellaneous lumber. The wood is soft to very soft and light to very light. The durability is very poor.

This species is found throughout the Philippines, and is distributed from eastern Africa to India through Malaya to northern Australia.

Family GUTTIFERAE

Genus CALOPHYLLUM

CALOPHYLLUM INOPHYLLUM L. (Fig. 54). BITÁOG or PALOMARIA DE LA PLAYA.

Local names: *Batárau* (Cagayan, Batanes); *bitáog* (Babuyanes, Abra, Union, Zambales, Ilocos Norte and Sur, Bataan, Leyte, Agusan); *bitáoi*

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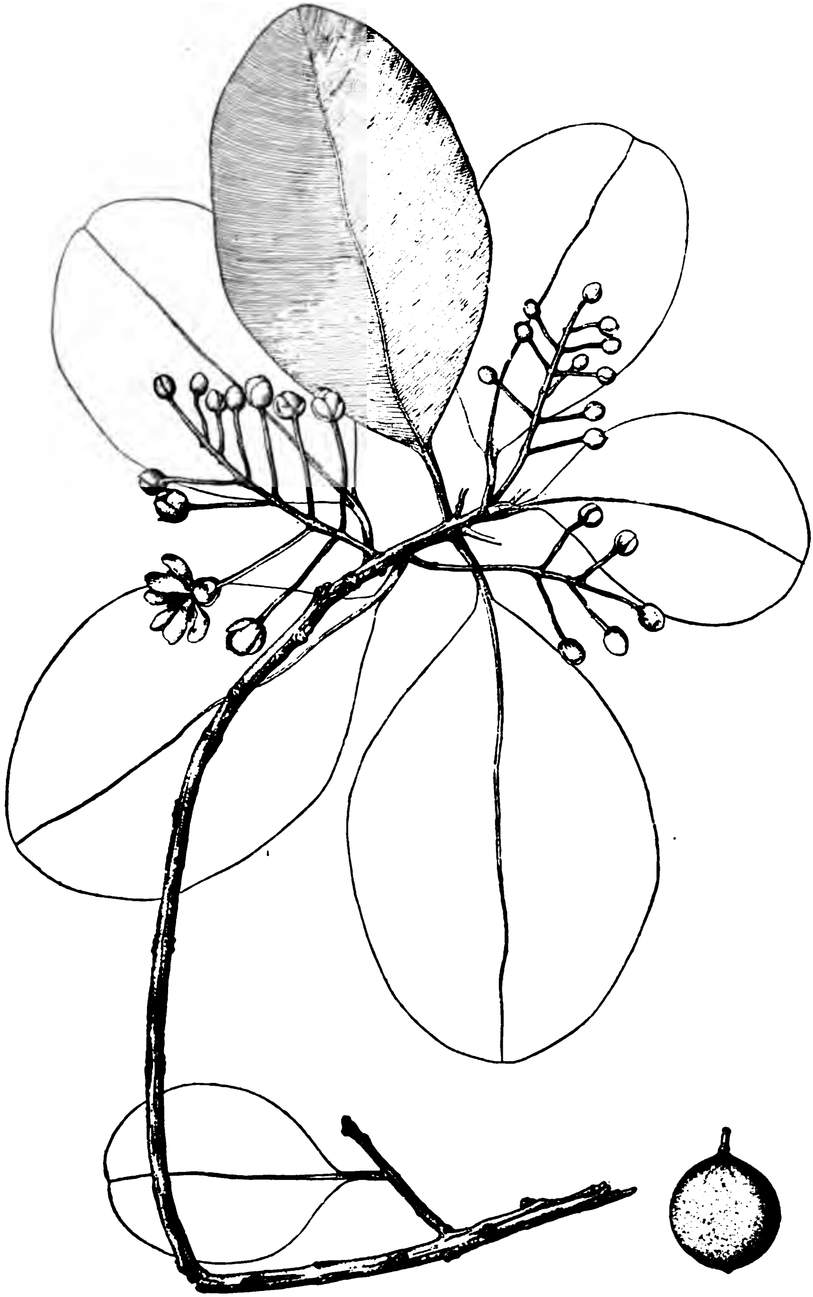
[*] Brill, H. C., and Agcaoili, F., Philippine oil-bearing seeds and their properties: II. Philippine Journal of Science, Section A, Volume 10 (1915), page 109.



J. Vilan del.

FIGURE 54. CALOPHYLLUM INOPHYLLUM (BITAOG OR PALOMARIA DE LA PLAYA), THE SOURCE OF PALOMARIA OIL.

(Pangasinan); *bitóng* (Bataan); *bit-táog* (Cagayan, Camiguin, Isabela); *bittóg* (Bataan); *butálau* (Batangas); *dagkálan* (Isabela); *dangkálan* (Bataan, Tayabas, Camarines, Albay, Mindoro, Masbate, Negros, Capiz, Lanao, Zamboanga, Burias Island, Butuan, Cotabato, Palawan); *dangkáan* (Davao); *palomaría* (Mindoro, Tayabas, Bataan, Zambales, Pangasinan, Nueva Ecija, Cagayan, Manila, Cebu, Zamboanga); *palomaria de la playa* (Bataan, Laguna, Camarines, Mindoro, Misamis, Zamboanga, Basilan); *pamittaógen* (Palaui Island); *tambo-tambo* (Jolo); *vutálau* (Batanes).

BITÁOG OIL

The seeds yield bitáog oil which is greenish-yellow in color and which in some districts is used as an illuminant. Each tree yields several bushels of nuts per year. According to Richmond and del Rosario * 70 to 75 per cent of this oil can be extracted from the kernels. They say that the oil is called domba and in Indo-English, improperly, laurel-nut oil. Concerning its uses they write:

> * * * The oil is not serviceable as an edible fat, since it contains a poisonous resin to which the color and odor are due. On the other hand, it finds application as a natural remedy in skin diseases and rheumatism, and it is used for that purpose in many districts of India; it is exported in considerable amounts from Travancore, particularly from Burma, and under the name of "udiloöl" it has been experimentated with in Europe for some time in the treatment of rheumatism.

The oil is said to be excellent for making soap.

G. Fenler † investigated the oil obtained from the nuts of *Calophyllum inophyllum* and states that it is greenish-yellow in color, has a bitter, pungent taste, and is soluble in all proportions in the usual solvents, but is insoluble in absolute alcohol. An examination of the oil gave the following constants:

Specific gravity at 15° C	0.942
Reichert-Meissl number	.13
Acid value	28.45
Saponification value	196
Iodine value	92.8

When heated with caustic soda the oil yields a greenish resin of semiliquid consistency, soluble in alcohol. The fatty acids consist largely of palmitic, oleic, and stearic acid.

Crevost ‡ states that Lefeuvre, by neutralizing the oil of *Calophyllum inophyllum* with caustic potash and separating the soaps

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[*] Richmond, G. F., and Rosario, M. V. del, Commercial utilization of some Philippine oil-bearing seeds: preliminary paper. Philippine Journal of Science, Section A, Volume 2 (1907), page 444.

[†] Chemiker Zeitschrift, Volume 29 (1905), page 15.

[‡] Crevost, Ch., Bulletin Economique de l'Indochine, New Series, Volume 8 (1906), page 394.

thus formed from the remaining oil, found that bitáog oil contains 71.55 per cent of fatty oil and 28.45 per cent of resin. The resin is dark brown in color and melts at 30° to 35°. It is soluble in benzine, carbon disulphide, petroleum ether, alcohol, and other organic solvents. The resin had an iodine value of 125.2 and the acid number (milligrams of caustic potash required to neutralize one gram of resin) was 180.8.

Since bitáog oil consists of a resin dissolved in a neutral oil, it is really a natural varnish and may be useful in the varnish industry.

Watt * says that the nuts are collected twice a year in India, and that they yield 60 per cent of oil.

The seeds of other species of *Calophyllum,* especially *Calophyllum blancoi* Pl. and Tr., also yield an oil used for illuminating purposes.

Calophyllum inophyllum has been grown sucessfully in plantations at Los Baños. In most cases the seeds showed fairly high percentages of germination. The average rates of growth of considerable numbers of trees are given in Table 27.

TABLE 27.—*Growth of Calophyllum inophyllum (bitaog) in plantations at Los Baños, Laguna.*

Age.	Diameter.	Height.
Years.	*cm.*	*m.*
2		.88
3		1.45
4	2	1.93
5	3	3.35
7	4	4.89

According to Crevost † the growth of this species seems to be very rapid, and at the end of two years some seedlings begin to produce fruits. He says that in less than four or five years one can hardly count on anything like a normal, annual production which would perhaps be about 20 to 40 kilos according to the age of the tree. Several highways in Cochinchina and Annam are entirely bordered with this species.

Calophyllum inophyllum is usually a medium-sized or large tree with a very short bole and dense, wide-spreading crown. It occurs on sandy beaches throughout the Islands. The bark is 12 to 20 millimeters thick, brown, with a decided yellow tinge, and has a tendency to divide into distinct ridges, which are often broken into irregular rectangular patches by cross fissures. The inner bark is pink to yellowish, with concentric lines of darker color. When the bark is cut, a sticky, yellowish sap exudes. The fruit is the size of a walnut. It has an outer fleshy portion and contains a thin-shelled seed with a hard, oily kernel.

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* Watt, George, The commercial products of India, (1908).

† Crevost, Ch., Bulletin Economique de l'Indochine, New Series, Volume 8 (1906), page 392.

This species is probably distributed in all parts of the Philippines bordering on the coast.

Family DIPTEROCARPACEAE

A fat known as Borneo tallow is obtained from certain dipterocarp trees, especially *Shorea, Hopea,* and *Isoptera.* Hefter * states that Borneo tallow is used in the Sunda Islands as food and for making soap. He says that it has a light green or yellow color and, when in a fresh condition, a pleasant taste, somewhat like that of coco butter.

According to Foxworthy,† this fat is used for manufacturing candles, for cooking purposes, and for lubricating machinery. He further says that it is derived chiefly from *Shorea* and *Isoptera,* and that the seeds of these species have a local value in Borneo of 7.50 dollars per picul.

Two species which Hefter says yield this product, *Shorea balangeran* (Korth.) Dyer and *Isoptera borneensis* Scheff., have been reported from the Philippines.

A tree that is called *Shorea balangeran* (gisok) is distributed in the Philippines from Luzon to Mindanao, but has never been collected in fruit. Foxworthy ‡ says:

> Our material credited to this species resembles very closely that shown in Korthals' original figure [Verh. Nat. Gesch. Bot. (1848) *t. 7*] in leaf and flower characters, except that there are more than fifteen stamens, in some cases about thirty, and the appendage to the connective is ciliate. The style is also shorter than that shown in the figure. I have not seen the type of *Shorea balangeran* and thus do not feel that it is desirable to describe our form as a new species. Much of our material is sterile. The fruit has not yet been collected.

The only records we have of the occurrence of *Isoptera borneensis* in the Philippines are seven collections from the District of Zamboanga, Mindanao, and from Camarines.

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* Hefter, G., Technologie der Fette und Öle, Volume 2 (1908), page 680.

† Foxworthy, F. W., Minor forest products and jungle produce. British North Borneo Bulletin No. 1 (1916), page 57.

‡ Foxworthy, F. W., Philippine Dipterocarpaceae, II. Philippine Journal of Science, Section C, Volume 13 (1918), page 187.

It would seem that it might be worth while to examine the seeds of other Philippine species of *Shorea* and also of species of *Hopea*, as there are in the Philippines 21 species of *Shorea* and 13 of *Hopea*.

Family FLACOURTIACEAE

Genus **PANGIUM**

PANGIUM EDULE Reinw. PAÑGI.

PITJOENG OIL

A description, figure, and the local names of this species are given in the bulletin on edible plants.

Pangium edule has seeds which yield about 50 per cent of pitjoeng, or samaun, oil having the following constants (Lewkowitsch):

Specific gravity	0.937
Saponification value	178–183
Iodine value	89.94
Titer test of fatty acids	44.4

According to Lewkowitsch:[*]

> The seeds contain a cyanogenetic glycoside of which some passes into the oil when it is prepared by the natives, and is only removed by prolonged boiling. The oil prepared in a very primitive fashion by the natives of Java, by heating the dry seeds and passing the mass between boards, is used as an edible oil.

Hefter[†] says that this oil is used as an illuminant and for making soap.

Family LECYTHIDACEAE

Genus **BARRINGTONIA**

BARRINGTONIA ASIATICA (L.) Kurz. BÓTONG.

Local names: *Balubitóon* (Guimaras Island); *bitóon* (Surigao); *booton, bótong* (Tayabas); *boton* (Tayabas, Camarines, Albay, Zamboanga); *lugo* (Cagayan); *palaupalau* (Negros).

BOTON OIL

Watt[‡] states that:

> In the Moluccas a lamp-oil is said to be expressed from the seeds of this plant. (*Treasury of Botany.*)

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[*] Lewkowitsch, J., Chemical technology and analysis of oils, fats, and waxes, Volume 2 (1914), page 496.

[†] Hefter, G., Technologie der Fette und Öle (1908), page 687.

[‡] Watt, G., Dictionary of the economic products of India, Volume 1 (1885), page 403.

According to Hefter,* Schädler reports that the seeds of this species yield an oil which should be good for illumination.

Barringtonia asiatica is a tree 8 to 15 meters in height. The leaves are 20 to 40 centimeters long, without individual stalks, shiny, larger near the apex than near the base, the apex rounded, and the base somewhat pointed. The flowers are very large. The petals are four in number, white, oblong, 7 to 8 centimeters long, and 3 to 4 centimeters wide. The stamens are very numerous, slender, united at the base, 10 to 12 centimeters long, white below, and shading to purple above. The fruit is sharply four- or rarely five-angled, 8 to 14 centimeters long, 8 to 12 centimeters thick, and contain a single large seed.

This species is distributed along the seashore throughout the Archipelago.

BARRINGTONIA RACEMOSA (L.) Blume. PÚTAT.

Local names: *Kutkut timbalong* (Zamboanga); *paling* (Cagayan); *putad* (Mindoro); *pútat* (Bataan, Manila, Laguna, Tayabas, Camarines, Mindoro, Polillo, Ticao, Sibuyan, Negros, Cotabato, Zamboanga).

PÚTAT OIL

According to Hefter,* Schädler reports that the seeds of this species yield an oil which should be good for illumination.

Barringtonia racemosa is a shrub or small tree reaching a height of 10 meters. The leaves are crowded at the ends of the branches, smooth, 10 to 30 centimeters long, pointed at both ends; the margins toothed. The flowers are white, or pink. The petals are 2 to 2.5 centimeters long. The stamens are very numerous and are 3 to 4 centimeters long. The fruit is ovoid to oblong ovoid, 5 to 6 centimeters long, somewhat four-angled, and green or purple.

This species is found throughout the Philippines in open lowlands and thickets near the seashore.

Family COMBRETACEAE

Genus TERMINALIA

TERMINALIA CATAPPA L. (Fig. 55). TALÍSAI.

Local names: *Almendra de Indias* (Spanish); *dalísai* (Cagayan); *logó* (Cagayan, Ilocos Norte and Sur, Abra, Union); *salaisáu* (Benguet); *salísai* (Zambales, Bataan); *savidug* (Batanes); *talísai* (Cagayan, Tarlac, Pampanga, Bulacan, Bataan, Rizal, Manila, Zambales, Laguna, Tayabas, Camarines, Mindoro, Albay, Sorsogon, Iloilo, Negros, Cotabato, Davao, Palawan); *talísi* (Basilan); *yalísai* (Tayabas).

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* Hefter, G., Technologie der Fette und Öle, Volume 2 (1908), page 331.

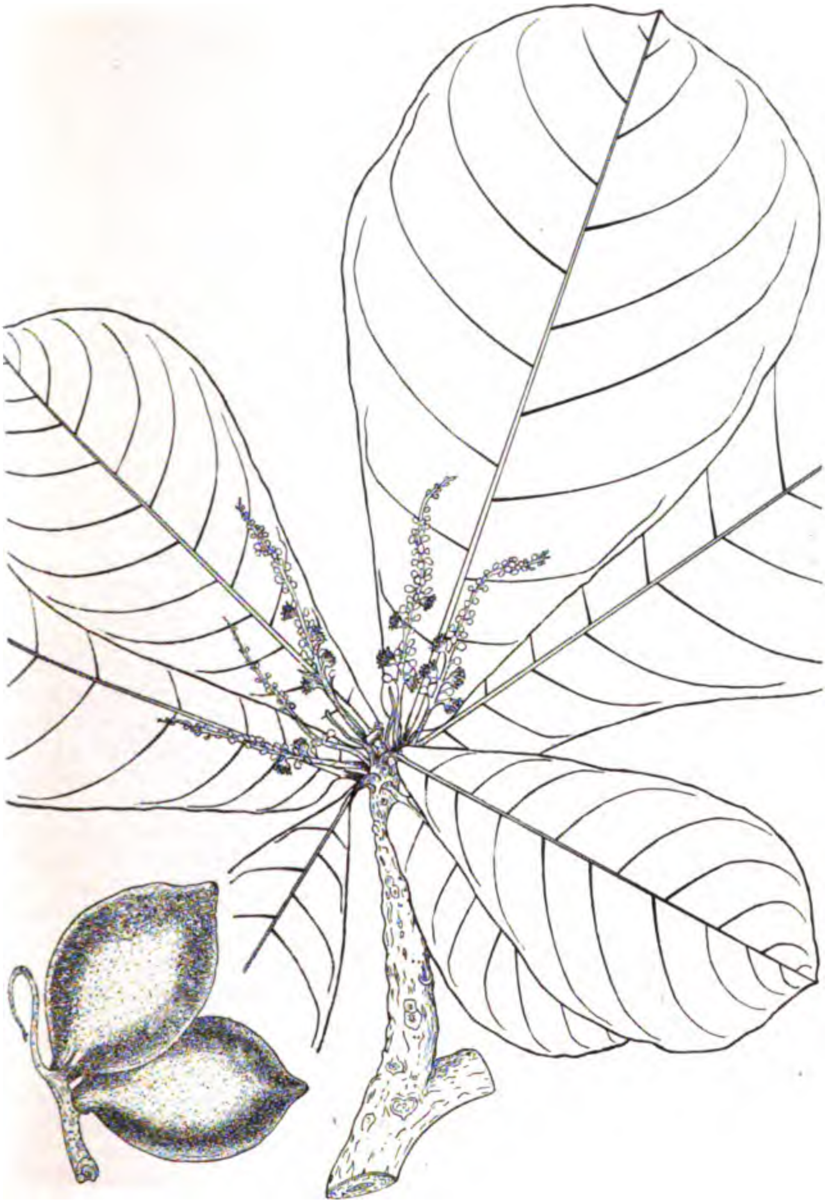

FIGURE 55. TERMINALIA CATAPPA (TALISAI), THE SOURCE OF INDIAN ALMOND OIL. ×½.

INDIAN ALMOND OIL

The kernel is edible and yields about 50 per cent of Indian almond oil, which is a sweet, savory, fixed oil. It closely resembles the oil of sweet almonds, for which it could well be substituted.

According to Lewkowitsch [*] the seeds of *Terminalia catappa* (country almond) contain 48.3 per cent of oil. Hooper [†] states that this oil has the following constants:

Specific gravity at 15° C	0.9206
Melting point, °C	3.5
Saponification value	203.04
	Per cent.
Iodine value	81.8
Insoluble acids + unsaponifiable	95.2
Titer test, °C	42
Acid value	7.77

Concerning this oil, Watt [‡] say:

> The kernels yield a valuable oil, similar to almond oil in flavour, odour, and specific gravity, but a little more deeply coloured; it deposits stearine on keeping. It possesses the advantage of not becoming rancid so readily as true almond oil, and if it could be produced cheaply would doubtless compete successfully with it. As the tree is abundant everywhere and the fruit could be doubtless obtained very cheaply, "Indian almond oil" appears to merit the attention of dealers. It was first brought prominently to notice by a Mr. A. T. Smith of Jessor, who in 1843 wrote to the Agr.-Horticultural Society of India an account of its properties and method of preparation. Oil, made experimentally by him, was expressed in the common native mill—a sort of pestle and mortar—from some fruit gathered during a few mornings from under the trees in the neighborhood. After a sufficient quantity had been gathered and allowed to dry in the sun for a few days, which facilitates breaking the nut, four coolies were set to work with small hammers, to separate the kernels from their shells. In four days they broke a sufficient quantity for one mill, *viz.*, 6 seers. This quantity put into the mill produced in three hours about 3 *pucka* seers of oil. Mr. Smith remarks that the actual pressing of the oil is of no consideration, since the value of the oil-cake, to feed pigs, etc., is sufficient to cover the expense, but that the breaking of the nuts is a tedious and costly operation, and is a consideration requiring particular attention, with a view to its reduction, if manufacture of the oil on an extensive scale should be attempted. The product of the experiment, filtered through blotting paper, was of the colour of pale sherry, a circumstance which Mr. Smith explains is due to the rind being allowed

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[*] Lewkowitsch, J., Oils, fats, and waxes. Volume 3 (1915), page 451.

[†] Hooper, D., Annual report, Indian Museum, 1907–1908, page 13.

[‡] Watt, G., A dictionary of the economic products of India, Volume 6, Part 4 (1893), page 23.

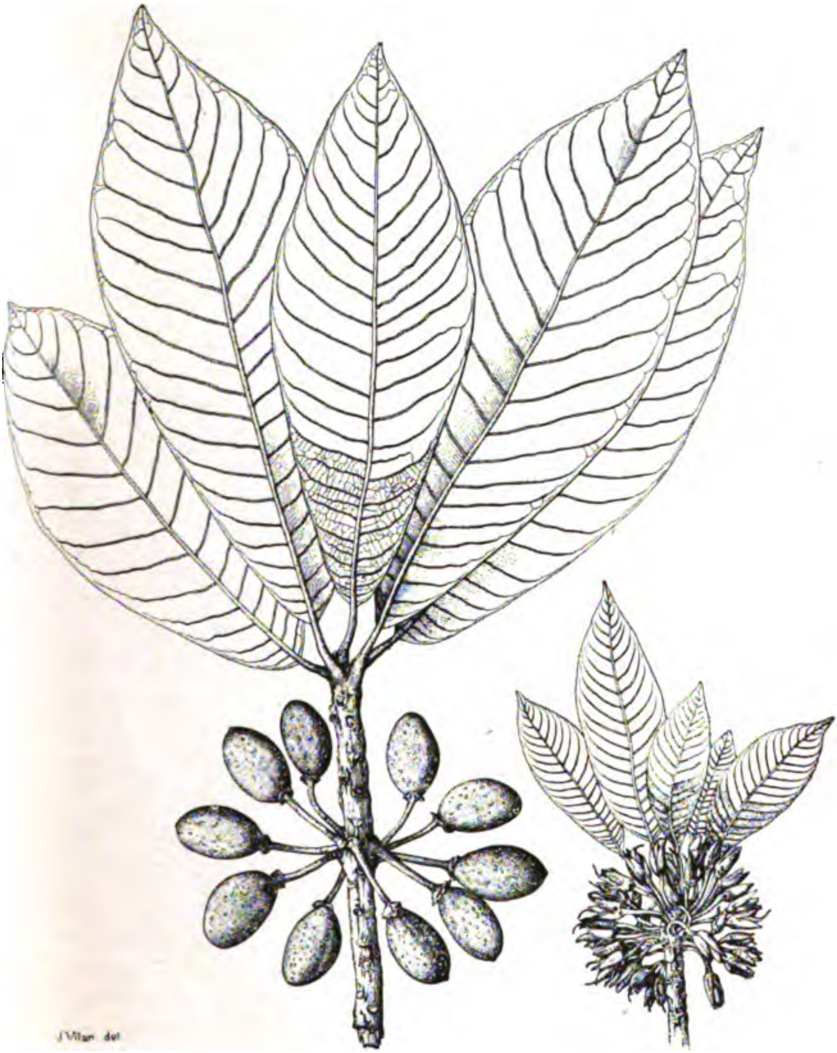

FIGURE 56. BASSIA BETIS (BÉTIS), THE SOURCE OF BÉTIS OIL.

to remain on the kernels. He concludes by remarking on the ornamental nature and utility of the tree for many other purposes, and recommends that it should be more extensively planted. A sample of the oil thus prepared was submitted for examination to Dr. Mouat, who reported as follows:—"I have compared the specimen with a good muster of the ordinary European almond oil in my possession, and find that in taste, smell, and specific gravity, the former is very similar to the latter, but is deeper in colour, becomes turbid in keeping, and deposits a quantity of white stearic matter. For most ordinary purposes, medicinal and otherwise, the former, I think, might profitably be substituted for the latter in this country, and, if expressed with greater care and freed from every impurity, might become an article of commercial value and importance" (*Journ. Agri.-Hort. Soc. Ind., ii.*). Though easily made edible and pleasant in flavour, it appears to have been entirely neglected by the Natives, who are ignorant as to its existence.

Terminalia catappa is a tree reaching a height of 25 meters. The leaves are 10 to 25 centimeters long, smooth, shiny, somewhat abruptly pointed at the tip, larger near the tip than near the base, tapering to a narrow, rounded or heart-shaped base. The flowers are small, white, and on axillary spikes 6 to 18 centimeters long.

This species is distributed near the seashore from northern Luzon to southern Mindanao, and is cultivated to some extent in and about Manila and many provincial towns as a shade tree.

Family SAPOTACEAE

Genus BASSIA

BASSIA BETIS (Blanco) Merr. (Figs. 56, 57). BÉTIS.

Local names: *Banitís* (Camarines); *bétis* (Rizal, Tayabas, Camarines); *betis-laláki* (Tayabas); *manílig* (Moro, Cotabato); *pásak* (Manila lumber-yards); *piañga* (Cagayan, Isabela).

BÉTIS OIL

The fruit of this tree contains an oil used locally as an illuminant.

Bassia betis is a tree reaching a height of about 30 meters and a diameter of about 1 meter. The leaves are smooth on the upper surface and very hairy below. They are pointed at both ends and about 20 to 25 centimeters in length. The flowers and fruits are borne in rounded clusters. The stalks of the flowers and fruits are about 3 centimeters long. The flower, exclusive of the long style, is about 1.5 centimeters in length. The fruit is somewhat oval, and 3 or 4 centimeters in length.

This species is distributed from Luzon to Mindanao.

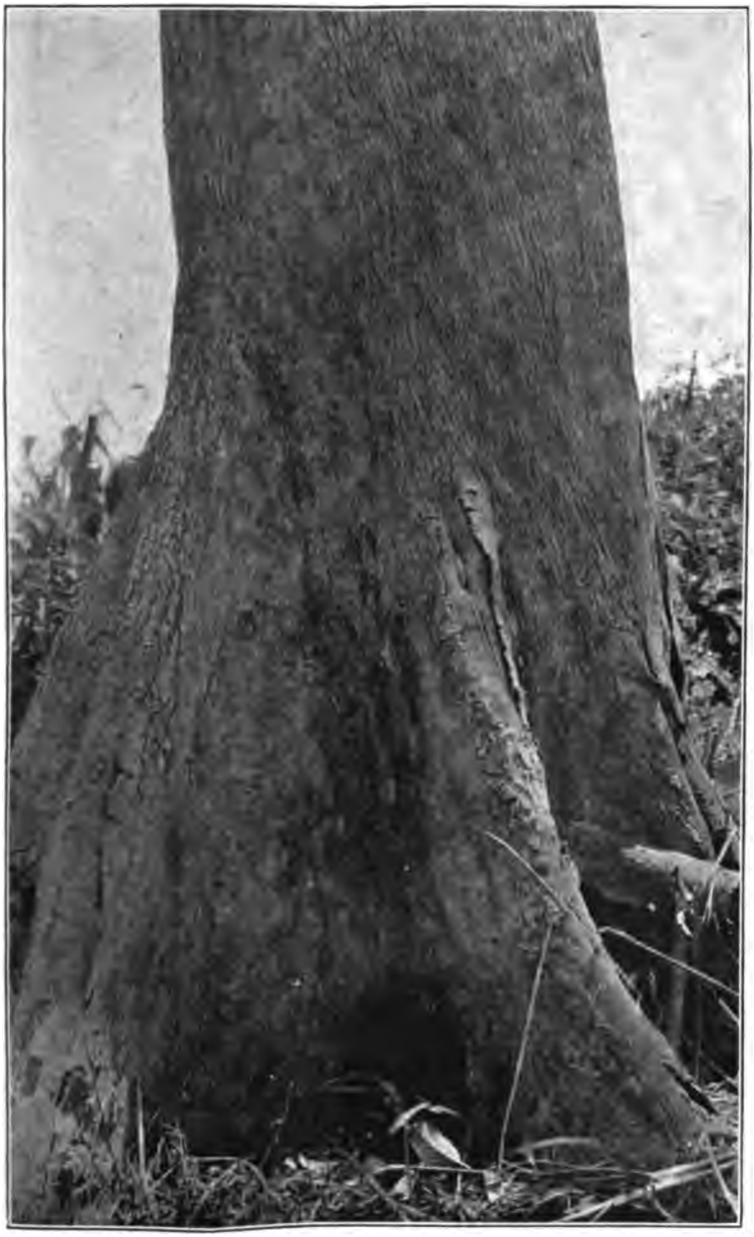

FIGURE 57. TRUNK OF BASSIA BETIS (BÉTIS).

Genus PALAQUIUM

PALAQUIUM PHILIPPENSE C. B. Rob. MALAKMÁLAK.

MALAKMÁLAK OIL

A description, figure, and the local names of this species are given in the bulletin on edible plants.

According to Blanco [*] the seeds yield a limpid, odorous oil which is employed in food and as an illuminant.

Several writers mention an oil which is said to be obtained in other countries from *Palaquium oleosum* Blanco. What this plant may be is doubtful as Blanco described no such species and no such name is listed in Index Kewensis. The use of the name *Palaquium oleosum* may be due to confusion with *Palaquium oleiferum* Blanco, which is a synonym of *Palaquium philippense,* a species apparently confined to the Philippines.

Family APOCYNACEAE

Genus CERBERA

CERBERA MANGHAS Linn. BARAIBÁI.

BARAIBÁI OIL

A description of this species and its local names are given in the bulletin on mangrove swamps.

Hefter [†] says that the seeds yield an illuminating oil.

Family PEDALIACEAE

Genus SESAMUM

SESAMUM ORIENTALE L. (Fig. 58). SESAME or LIÑGÁ.

Local names: *Lañgis* (Pangasinan, Pampanga); *lañgá* (Camarines, Albay); *leñgñgá* or *liñgñgá* (Ilocos Norte and Sur, Abra, Pangasinan); *liñgá* (Tagalog provinces, Marinduque, Misamis, Cuyo Islands, Zamboanga); *luñgá* (Capiz and other Bisayan provinces).

BARAIBÁI OIL.

The whole seeds of *Sesamum orientale* are utilized locally by Chinese bakers in making various cakes and sweetmeats.

Sesame oil, also known as pil, or gingelly, is obtained by expressing the seeds of the sesame plant. The yield of oil thus obtained varies from about 50 to 57 per cent. The white or yellow seeded varieties furnish the best grade of oil, while the dark red, brown, or black seeded varieties give an oil of somewhat inferior grade. Sesame oil has a pale yellow color and a pleasant odor and taste.

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[*] Blanco, M., Flora de Filipinas (1845), page 282.

[†] Hefter, G., Technologie der Fette und Öle, Volume 2, page 501.

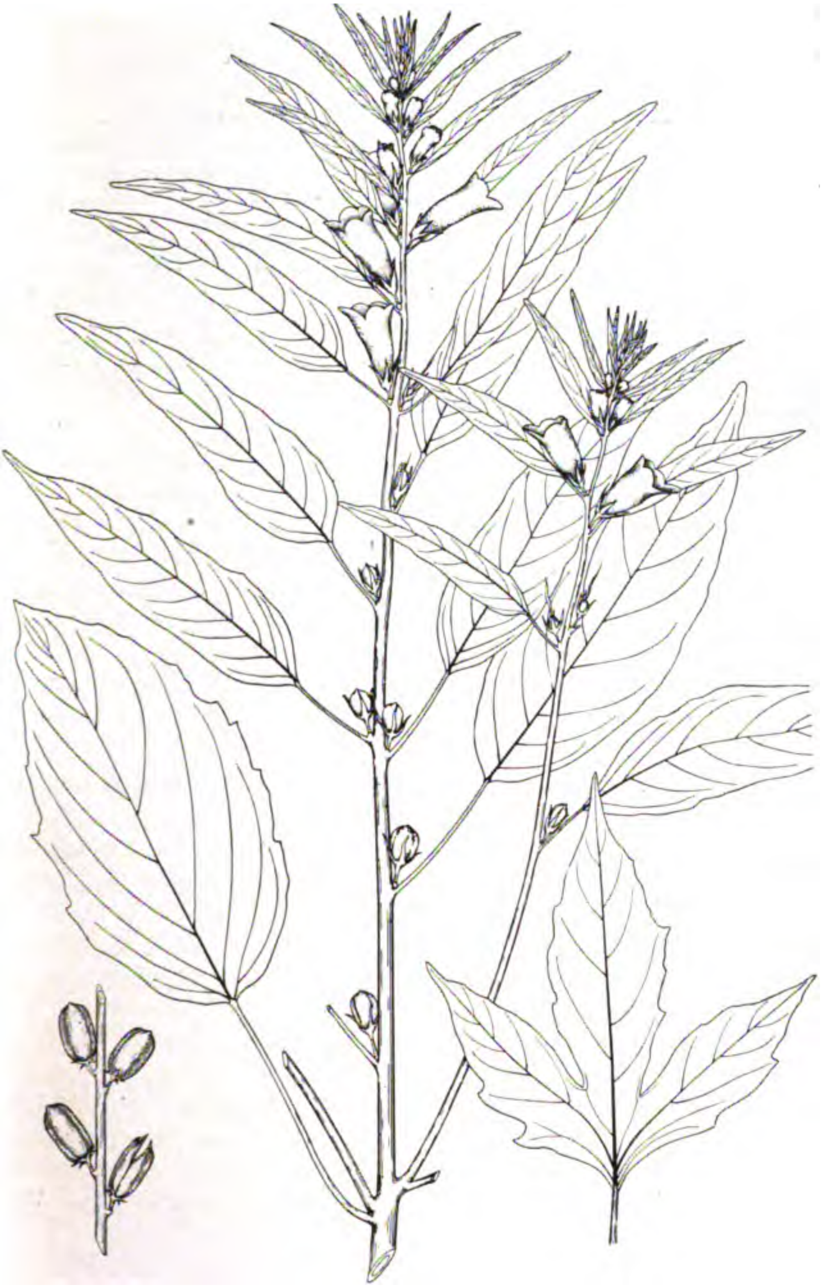

FIGURE 58. SESAMUM ORIENTALE, THE SOURCE OF SESAME OIL. ×½.

The Philippine exports of sesame seed and oil for several years are given in Table 28.

TABLE 28.—*Amount and value of sesame seeds and oil exported from the Philippines from 1914 to 1918.*

Year.	Seeds.		Oil.	
	Amount.	Value.	Amount.	Value.
	Kilograms.	*Pesos.*	*Kilograms.*	*Pesos.*
1914	53,135	7,328		
1915	62,881	7,464		
1916	316,198	45,675		
1917	168,878	27,558		
1918	120,802	30,661	6,248	1,250

The best quality of sesame oil is obtained from the first expression in the cold, and is used for edible purposes such as the manufacture of margarine, which is an artificial butter or butter substitute. Oils of the second or third expression are employed particularly in soap making. After the free fatty acids have been removed from the lower grades, they are likewise useful for illuminating and lubricating purposes.

The oil cake contains about 9 per cent of oil. It serves as an excellent cattle food. Oil cake which has been extracted with solvents serves as fertilizer.

Before the war, sesame seeds were chiefly crushed on the continent of Europe. In several continental countries the inclusion of a certain quantity of sesame oil in margarine was compulsory, to facilitate its detection when used to adulterate butter. This factor raised the price, with the result that the British margarine producers substituted other oils, said to be cheaper and equally good. The seed is, however, now crushed in England, and it has been predicted that this practice will continue and extend if the price of the seeds remains at about the same level as that of the other oil seeds.*

In India and other eastern countries, the oil is expressed by primitive methods and employed largely in cooking, for anointing the body, and for lamps. About 400,000 tons of sesame seeds per year are used in India; in Burma about 100,000 tons. The average annual export from India is about 100,000 tons. India also exports about 180,000 tons of oil annually. The total imports of sesame into Europe in 1913 amounted to about 250,000 tons. In India the average value per ton of seeds is about 150 pesos. In Indo-China the yield of seeds varies from 300 to 800 kilos per hectare.*

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* The oil-seed industry of Rhodesia. Bulletin of the Imperial Institute, Volume 15 (1917), page 477.

According to The American Perfumer: †

> The oil from the black variety of sesame is generally stated to be more suitable for medicinal purposes than the white. It is also extensively employed in the manufacture of Indian perfumes, and for this purpose the perfume is frequently extracted by the seeds direct—layers of the seeds being placed between layers of flowers, etc. Thus a favorite jasmine extract in India is made by layers of sesame seed wetted in water being placed alternately with layers of jasmine flowers, all being covered with a cloth and left for 12 to 18 hours, after which an oil is obtained that has all the scent of the flower.

As regards the composition of sesame oil, Mitchell ‡ says:

> It consists, in the main, of the glycerides of oleic and linolic acid, with smaller quantities of the glycerides of solid fatty acids, including stearine, palmitin and myristin. The unsaponifiable matter (1 to 1.4 per cent.) consists of a phytosterol, a crystalline dextrorotatory substance, *sesamin,* and a substance termed *sesamol,* which reacts with furfural and hydrochloric acid.

Thorpe § in discussing the composition of sesame oil states:

> Sesame oil contains from 12 to 14 p. c. of solid acids, the remainder consists of oleic and linoleic acids. Sesame oil is dextro-rotatory, a property which may supply a useful additional means of identifying the oil. The optical activity is no doubt due to the presence of phytosterol and sesamin which form the bulk of the unsaponifiable matter in sesame oil. In addition thereto, there occurs in the unsaponifiable matter a thick non-crystallisable oil which gives the characteristic colour reaction known as the "Baudouin."

Lewkowitsch ‖ gives the constants of sesame oil:

Specific gravity (15°), 0.9230 to 0.9237.
Solidifying point –4° to –6°.
Saponification value (Mgrms KOH) 188.5 to 190.4.
Iodine value 106.9 to 107.8.
Maumené test 63° to 72°.
Refractive index (15°), 1.4748–1.4762.
Oleo-refractometer (22°), +13° to +17°.
Butyro-refractometer (25°), 68° to 68.2°.

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* Indian trade in oil seeds. Bulletin of the Imperial Institute, Volume 15 (1917), page 405.

† The American Perfumer, Volume 10 (1915–1916), page 244.

‡ Mitchell, C. A., Edible oils and fats (1918), page 69.

§ Thorpe, E., Dictionary of applied chemistry, Volume 4 (1912), page 661.

‖ Lewkowitsch, J., Oils, fats, and waxes, Volume 2 (1915), page 210.

Thorpe * states that sesame oil cake has the following average composition:

	Per cent.
Oil	14.63
Moisture	7.65
Proteins	36.14
Ash	13.17
Crude fiber	4.83
Carbohydrates	23.58

Sesamum orientale is an erect, annual herb 50 to 80 centimeters or more in height. The leaves are 3 to 10 centimeters long, the lower often lobed, the middle ones toothed, the uppermost almost entire. The petiole is from 1 to 5 centimeters long. The corolla is about 3 centimeters long, hairy, whitish, or with purplish, red, or yellow marks. The capsule is about 2.5 millimeters long and split half-way or quite to the base.

This plant is widely cultivated in the Philippines and is occasionally spontaneous. It is probably a native of tropical Africa, but is now widely distributed in tropical and subtropical countries.

The black-seeded variety of *Sesamum orientale* has been grown in the Philippine Islands as a minor crop for many years; the white-seeded variety, which produces a finer grade of oil, has been recently introduced.

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* Thorpe, E., Dictionary of applied chemistry. Volume 4 (1912), page 661.

ESSENTIAL OILS

The natural essential oils are the volatile, odoriferous oils obtained from plants. By volatile is meant that if one of these oils is exposed to the air it will gradually evaporate. These volatile oils may occur in the bark, root, leaves, or other parts of the plant, but usually they are most abundant in the fruits or flowers. Many of these essential oils have a pleasant taste and a very fragrant odor, like that of fruits or flowers. They are employed extensively in the manufacture of various substances for which there is a great demand; as in perfumes, toilet waters, scents (face and sachet powders), and in essences which serve as flavoring materials for confectionery and for beverages like lemonade and liqueurs. They are also used in medicinal preparations to conceal nauseous odors and tastes.

Perfumes have been in vogue since the earliest times, and records show that the ancient Egyptians introduced perfumes in their religious services. In certain countries vast tracts of land are devoted to the cultivation of flowers from which fragrant perfumes are obtained. In southern France large quantities of various flowers are raised commercially for the production of natural perfumes. In the French Riviera district alone the annual revenue from cultivated flowers such as roses, carnations, and violets, is over ₱24,000,000. Roses are cultivated extensively in Bulgaria, while in the Philippines ilang-ilang is grown to a certain extent. In the Philippines there are a number of perfume plants which are the bases of considerable industries in other countries, but which are not so utilized in the Philippines. Among these are patchouli, lemon grass, and vetiver.

Various methods such as steam-distillation, extraction with fats (preparation of flower pomades), and extraction with volatile solvents are used to obtain the perfume oils from flowers.

As in the case of seed oils, the purity of essential oils is ascertained by determining certain essential-oil constants such as the specific gravity, optical rotation, and especially the ester number, as the value of many oils depends largely upon the presence of a quantity of certain esters. The real value of an oil, however, is determined by the exact odor it possesses. This fragrance is due to certain chemical compounds, numbers of which exist in the flowers only in very minute quantities. Many of the chemical substances inherent in plants may be prepared synthetically. However, the odor of these synthetics is quite different from that of the flowers, for the latter's scent can be secured only when all the substances contained in the flower are combined in the proper proportions. The fragrant flower was the first perfume and still is the first. Although a large number of synthetic perfumes are manufactured, the consumption of natural perfumes is increasing. The former are frequently used to fortify the natural perfumes and are also mixed with them to produce new blends.

Family GRAMINEAE

Genus ANDROPOGON

ANDROPOGON CITRATUS DC. TANGLÁD or LEMON GRASS.

Local names: *Baróniw* (Pangasinan); *tañglád* (Tagalog, Bikol).

LEMON-GRASS OIL

This grass is frequently cultivated, especially in India and Ceylon, for its fragrant leaves. Bacon [*] remarks that in the Philippines:

> It is cooked with stale fish to improve the taste and is used as a flavor in wines and various sauces and spices; it is also used medicinally, being applied to the forehead and face as a cure for headache, and an infusion is held in the mouth to alleviate the suffering of toothache.

The roots resemble ginger in flavor, though less pungent. They are used as a condiment and for perfuming hairwashes of gogo.

When the grass is distilled it yields commercial lemon-grass oil, or Indian verbena oil, which has a reddish-yellow color and the intense odor and taste of lemons. Lemon-grass oil is used in making perfumes, especially ionone (synthetic essence of violets).

According to Hood [†] about 100,000 pounds of lemon-grass oil are used annually in the United States and the consumption of it for the manufacture of ionone and other perfumery purposes is continually increasing. He describes the distillation of the grass as follows:

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[*] Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), page 111.

[†] Hood, S. C., Possibility of the commercial production of lemon-grass oil in the United States. United States Department of Agriculture Bulletin No. 442 (1917).

> The apparatus required for the distillation of lemon-grass oil does not differ from that in general use for the distillation of other volatile oils. Before distilling the plants it has been found advisable to run them through a fodder cutter, in order to permit closer packing in the retort. From the data at hand it is estimated that if the plants are cut into 2-inch lengths a retort will hold 100 pounds of material for every 6 cubic feet of space, but if the plants are put in whole the quantity which the retort can hold will be somewhat less. The closer packing, however, in no way facilitates distillation.
>
> In a retort having a capacity of 30 cubic feet a charge of 3,000 pounds can be distilled in 2 to 2½ hours by the steam which may be readily generated in a small farm boiler, and by the use of a larger volume of steam the time can be much reduced.
>
> After the oil has been distilled it should be freed from water so far as possible in a separatory funnel, then dried by shaking with anhydrous calcium chloride, and filtered. It should be stored in well-filled air-tight containers in as cold a place as possible until ready to be shipped to market. The shipping can be done in new and clean tin cans without injury to the product.

Leach,* in discussing lemon extracts, states:

> The flavor of the cheap extracts is sometimes reinforced by the addition of such substances as citral, oil of citronella, and oil of lemon grass, but minute quantities only of these pungent materials can be used, not exceeding 0.33 per cent in the case of citral, and 0.1 per cent in the case of the two last mentioned oils.

According to Askinson,† essence of lemon grass consists of 2 ounces of lemon-grass oil dissolved in 1 gallon of alcohol.

Lemon-grass oil consists largely of citral and contains also small quantities of various substances such as methyl heptenone, and the terpenes, limonene and dipentene. The exact value of the oil depends chiefly upon the amount of citral it contains. High-grade oils contain about 70 to 80 per cent of citral. This is an aldehyde which occurs not only in lemon-grass oil, but also in lemon oil (the oil obtained from lemon peel) and in many other natural essential oils.

Bacon investigated lemon grass grown at the Government experimental station at Lamao, Bataan, in unfertilized soil. Concerning his results on these plots of grass he states:

> *Lamao.*—Planted February 14, 1908. First cutting July 29, 1908. Obtained 432 kilos grass, from 57 square meters of ground, distilled two days after cutting, the yield was 900 grams of oil (0.2 per cent) of the following properties: Specific gravity, $\frac{30^\circ}{4^\circ} = 0.894$; $N\frac{30^\circ}{D} = 1.4857$; $A\frac{30^\circ}{D} = +8.1$; citral=79 per cent; Schimmel's test passes the oil.

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* Leach, A. E. Food inspection and analysis (1914), page 872.

† Askinson, G. W., Perfumes and cosmetics, page 161.

Bacon thought that lemon grass should be considered as a possible catch crop for the first few years of new Philippine plantations. He did not recommend it as a permanent crop on account of the limited demand for the oil. The grass from which oil has been extracted is burned under the distilling boiler and the ashes distributed over the fields as fertilizers. The exhausted grass is also used for making paper.

Lemon grass is a tufted perennial with leaves up to 1 meter in length and 1.4 centimeters in width. It is widely distributed, but not extensively cultivated in the Philippines and does not grow outside of cultivation.

ANDROPOGON NARDUS var. HAMATULUS Hack.

CITRONELLA OIL

The typical form of this species is cultivated in India, Ceylon, and other tropical countries for the essential oil obtained from it. It probably could be cultivated in the Philippines also. When this grass is distilled it yields a pale yellow oil, which has a very strong odor and is known commercially as citronella oil.

As the variety *hamatulus*, which occurs in the Philippines, has not been investigated chemically, it is not certain that it will yield citronella oil.

On account of its low price, citronella oil is used chieflly for perfuming cheap soaps and also as a protection against the bites of insects. An ointment containing 25 per cent of oil of citronella is an excellent protection against mosquitoes. According to Parry[*] pure citronella oil has the following constants:

Specific gravity	0.900 to 0.915
Rotation	0° to –15°
Sp. gr. of 1st 10 per cent (distilled at 20–40 mm.)	above 0.858
Refractive index of same at 20°	above 1.4570
Solubility in 80 per cent alcohol	to pass Schimmel's test
Geraniol and citronella	above 58 per cent

(Calculated as total geraniol).

Parry describes methods for preparing pure citronella oil. He also discusses methods for determining the purity and the presence of adulterants.

Askinson[†] states that essence of citronella contains three ounces of citronella oil dissolved in one gallon of alcohol.

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[*] Parry, E. J. Chemistry of essential oils and artificial perfumes, (1908), page 171.

[†] Askinson, G. W., Perfumes and cosmetics (1915), page 161.

The variety *hamatulus* is of very local occurrence in the Philippines, is nowhere cultivated, and is apparently not used in the Archipelago. It is distributed from the northern to the southern limits of the Philippines.

ANDROPOGON ZIZANIOIDES (L.) Urb. (Fig. 59). VETIVER or MORAS.

Local names: *Amóra* (Cebu); *amóras* (Ilocos Norte); *aniás* or *aniás de móras* (Pampanga); *anís de móro* (Ilocos Sur, Abra); *gerón*, *girón* (Iloilo); *ilib* (Pampanga); *móra* or *móras* (Pampanga, Tarlac, Rizal, Manila, Laguna, Camarines, Albay, Sorsogon, Antique, Cebu, Occidental Negros); *rimódas* (Capiz); *rimóra* (Zambales); *rimóras* (Camarines); *tres móras* (Capiz).

VETIVER OIL

Oil obtained from the roots of this grass is known as *vetiver* and also as *cuscus*. The oil is obtained by steam-distilling the roots which are first macerated in water. It has been employed as an aromatic, carminative and diaphoretic. It is used considerably as a constituent of high grade perfumes and also as a perfume fixative, which makes the odors less volatile and more lasting.

According to Askinson,* the roots are used in India for making fragrant mats, while shavings are employed for filling sachet bags. The odor of the roots is somewhat similar to that of sandal wood. Fans made of the roots are sold in oriental-curio shops in the United States under the name of "sandal-root" fans. Piesse † states that in Calcutta, vetiver (vitivert or kus-kus) is made into awnings and sunshades. During the hot season the shades are sprinkled with water, the evaporation of which cools the apartment, while the atmosphere is perfumed with the fragrant odor.

In the Philippines, the roots are woven into fans which are prized on account of their agreeable odor. The stalks are also used for making hats, while the leaves are sometimes employed for thatching.

According to Watt,‡ the roots of *Andropogon zizanioides*—

> * * * When distilled with water yield a fragrant Oil (known in European trade as *Vetiver*, which is used as a perfume and for flavouring sherbet. It commands a high price in Europe, being employed in many favourite scents. It is the most viscid of essential oils, and hence its sparing volatility is taken advantage of in fixing other perfumes. The oil is hardly, if ever, exported from India, European supplies being either locally

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* Askinson, G. W., Perfumes and cosmetics (1915), pages 54, 173, 225.

† Piesse, C. H., Art of perfumery (1891), page 233.

‡ Watt, George, The commercial products of India (1908), page 1106.

made from the Indian roots or derived from Réunion. According to Piesse, the yield is about 10 oz. per cwt.; other observers have found it to vary from 0.2 to 3.5 per cent. * * *

The odor of vetiver, Parry * says, does not resemble that of orris root, but has a similar effect in perfumery. Vetiver essence is obtained by treating three pounds of the dried roots with one gallon of alcohol. It is used in making various high-grade bouquet perfumes. Parry states that from the standpoint of practical perfumery vetiver oil is said to blend excellently with the odors of orris root and cassie flowers. Askinson says that vetiver essence consists of 2 ounces of vetiver oil dissolved in one gallon of alcohol, and vetiver sachet powder of 2 pounds of vetiver roots, 15 grains of musk, and 20 grains of civet.

According to Bacon,† the distillation of the greater part of vetiver oil is carried on in Europe. Neither the roots nor the oil appear to be exported from the Philippines. The roots are sold in the large public markets of the Philippines in small lots at from 15 to 25 centavos per kilo. They are usually laid away with clothing to impart a pleasant odor. Bacon believed that the cultivation and distillation of this grass offered commercial possibilities in the Philippines.

Parry ‡ states that Schimmel investigated this oil and obtained the following results:

Specific gravity	1.019 to 1.027
Optical rotation	+25° to +26°
Ester number (as per cent KOH)	7 to 8
Solubility in 80 per cent alcohol	1 in 1½ to 2

Singh § distilled seven samples of vetiver roots and found that the yield of oil obtained varied from 0.45 to 1.14 per cent The resin contained in the oil was eliminated by redistillation and the refined oil then gave a negative optical rotation (–30.65°).

An extensive investigation of vetiver oil and a review of the literature on this subject has been made by Semmler, Risse, and Schröter.‖ The oil used by these investigators was prepared by Schimmel. They obtained from vetiver oil various substances

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* Parry, E. J., Chemistry of essential oils and artificial perfumes (1908), page 186.

† Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), page 118.

‡ Parry, E. J., Chemistry of essential oils and artificial perfumes (1908), page 186.

§ Singh, Puran, American Perfumer, Volume 10 (1915–1916), page 133.

‖ Semmler, F. W., Risse, F., and Schröter, F., Berichte der Deutschen Chemischen Gesellschaft. Volume 45, II (1912), page 153.

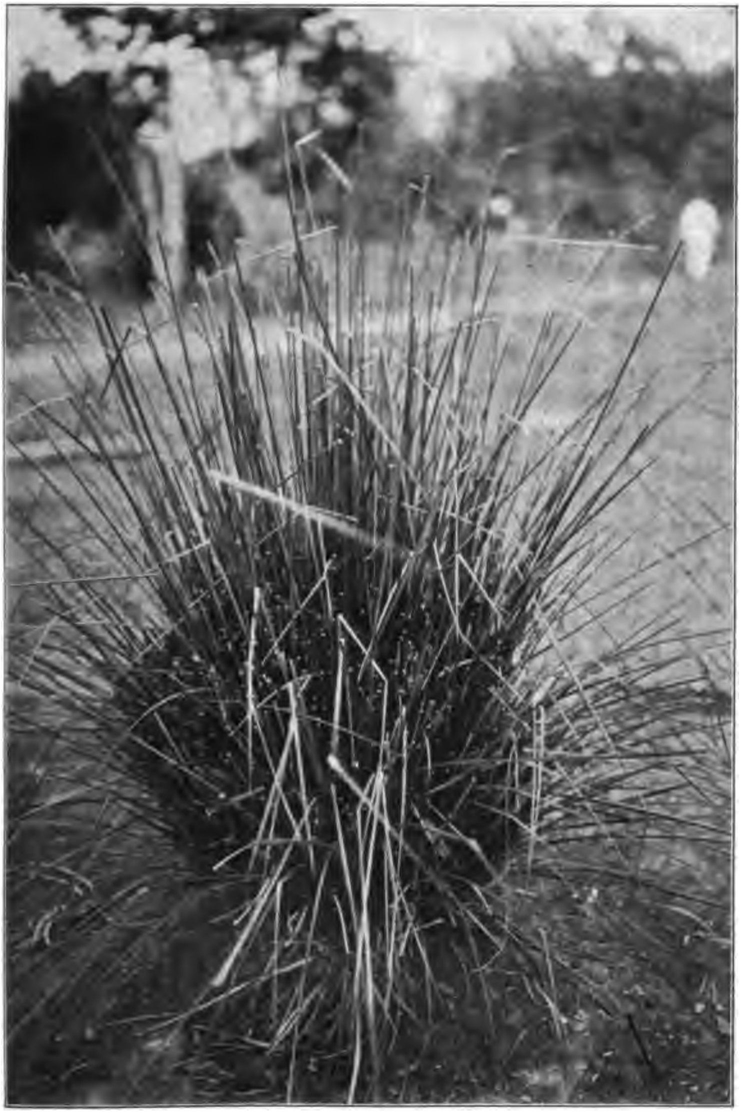

FIGURE 59. ANDROPOGON ZIZANIOIDES (VETIVER OR MORAS), THE SOURCE OF VETIVER OIL.

such as the vetivenes, vetivenol, vetivenic acid, vetivenyl acetate, and similar compounds.

Bacon * reports the results of his investigation on vetiver as follows:

> (1) Thirty kilos of fresh vetiver roots were distilled for two working days (seven hours each) with steam, the condensed water being continually poured back over the roots, and the oil collected in a little petroleum ether to effect easier separation from the water, as the vetiver oil has almost the same specific gravity as water. The petroleum ether was distilled *in vacuo* and there were thus separated 327 grams of a light yellow oil (1.09 per cent) which had a very strong, pleasant odor and the following properties: Specific gravity, $\frac{30^\circ}{4}$ =0.9935; A $\frac{30^\circ}{D}$ =+32.1; N $\frac{30^\circ}{D}$=1.5212 saponification number =47.4
>
> The roots used in the above experiment were obtained from small gardens about Manila and were crushed between the rollers of a sugar mill before being distilled. Such a crushing of the roots seems to improve the yield of oil.
>
> (2) Thirty-one kilos of fresh roots, uncrushed, on distillation as above gave 140 grams oil (0.3 per cent).
>
> (3) Six kilos of dried roots, uncrushed, gave by extraction with ligroin 14 grams of an oil which had only a very slight vetiver odor.
>
> (4) Eighty-one kilos of dry *moras* which had been stored in jute sacks for about three months after harvesting, were distilled with steam with continuous cohobation and yielded 370 grams of oil (0.456 per cent) of an intense odor and brown color. This oil had the following properties: Specific gravity, $\frac{30^\circ}{4^\circ}$ =0.9964; N $\frac{30^\circ}{D}$=1.5163; A $\frac{30^\circ}{D}$=+32.1; saponification number=60.0.
>
> It is to be noted that this oil with a higher saponification number has a much stronger odor than that obtained in experiment 1 given above (saponification number =47.4
>
> (5) A plot of well-fertilized ground containing 150 square meters was planted with vetiver grass. In six months time the plants had flowered and reached maturity; they were then removed, giving 270 kilos of roots, or at the rate of over 18,000 kilos per crop per hectare. However, it was found when these roots were transferred to the laboratory, that they had lost most of their odor, and they gave so small a yield of oil as not to make it worth while to distill them. Some of these plants had been pulled up from time to time and tested for their oil content; they seem to contain the oil up to the time of flowering.
>
> These preliminary experiments seemed to indicate that the proper time for harvesting is about three months after planting, at which time, of course, the yield of roots is not nearly so heavy. The oil in the roots is a protection, and is withdrawn when the plant flowers and seeds. We have planted all of our vetiver by simply burying pieces of divided root tufts in the ground. We have as yet made no experiments on the propagation of the grass from the seed. It was found that the roots can very con-

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* Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), page 119.

veniently be harvested by washing away the soil with a stream of water, catching detached rootlets with a coarse screen. One hundred plants of the above lot, treated in this manner, gave 60 kilos of roots (wet), and 100 plants at Parañaque in a sandy beach soil, gave 23 kilos of roots. The latter were presumably three to four months old and contained a large percentage of oil.

Andropogon zizanioides is a coarse, erect, tufted, perennial grass 1 to 2 meters in height. It has fragrant, fibrous roots. The leaves, arranged in two rows, are about 1 meter long, 1 centimeter or less in width, and folded. The panicles are terminal, erect or greenish, and about 20 centimeters long.

This grass abounds in all parts of the Archipelago. It is identical with the *khus-khus* or *khas-khas* of India. It grows abundantly in Burma and is also found in Réunion, Mauritius, and the West Indies.

Family ARACEAE

Genus ACORUS

ACORUS CALAMUS L. LUBIGÁN or SWEET FLAG.

Local names: *Acóro* (Spanish); *bueng* (Pampango); *lubigán* (Tagalog, Bíkol, Bisaya); *dálau* (Ilocos Sur, Abra, Union); *dárau, dengau* (Bontoc).

CALAMUS OIL

The rhizome of sweet flag has an agreeable, aromatic odor, and when powdered is used for sachet and toilet powders. The rhizome yields calamus oil when distilled. This oil is used for the preparation of aromatic cordials and liqueurs, for flavoring beer, and also in making perfumes. Throughout the Malayan region and the Philippines it is highly prized for medicinal purposes.

Askinson * gives the essence of calamus as consisting of 1¾ ounces of calamus oil dissolved in 5 quarts of alcohol. Although this essence has a pleasant odor, it is not a very valuable perfume and is usually employed as a basis for cheap perfumery preparations.

Parry † states that Schimmel obtained 0.8 per cent of oil from the dried rhizome, while the fresh rhizome yielded about 2.0 per cent. According to Parry, a thorough chemical investigation of this oil has not been made. However, it is supposed to contain pinene and a sesquiterpene. Schimmel found that the specific gravity varied from 0.960 to 0.970 and the optical rotation from + 10° to + 35°. Oil from the Japan calamus root, however, gave a specific gravity of 1.000. Pure samples of calamus oil are soluble in 90 per cent alcohol and should yield no distillate below 170°.

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* Askinson, G. W., Perfumes and cosmetics, (1915).

† Parry, E. J., The chemistry of essential oils and artificial perfumes. (1908).

Acorus calamus has stout, branched, aromatic rhizomes. The leaves are flat, smooth, 25 to 60 centimeters long, and 1 to 1.5 centimeters wide. The spathe is green, much elongated, and similar in shape to the leaves. The spadix is 3 to 5 centimeters long, 1 centimeter or less in diameter, and bears many flowers.

This species occurs throughout the Philippines as a cultivated plant. In the Mountain Province, Luzon, at and above an altitude of 1,400 meters, it is sometimes found growing wild in swamps in great abundance. However, this plant has apparently been introduced into the Philippines.

Family ZINGIBERACEAE

Genus CURCUMA

CURCUMA LONGA L. DILÁU OR TURMERIC.

Local names: *Áñge* (Pampanga); *azafrán* (Spanish in Zamboanga); *barák* (Cuyo Islands); *dálau* (Iloko in Cagayan); *diláu* (Bataan, Rizal, Manila, Laguna, Batangas, Tayabas); *dilau-pulá* (Laguna); *duláu* (Leyte, Capiz, Iloilo, Cuyo Islands); *kalauág* (Camarines, Albay, Zambales); *kulálau* (Pangasinan); *kúnig* (Ilocos Sur, Cagayan); *luyang-diláu* (Batangas).

DILÁU OIL

The rhizomes of *Curcuma longa* are used extensively in the Philippines as a condiment and for food coloration and also as an ingredient of curry.

Bacon * found that when 123 kilos of roots were distilled, 290 grams of a brown-colored oil were obtained. The constants of this oil were as follows: Specific gravity, $\frac{30^\circ}{30^\circ}=0.930$; refractive index $N\frac{30^\circ}{D}=1.5030$; optical rotation, $A\frac{30^\circ}{D}=8^\circ.6$; ester number, 81; miscible with 75 per cent alcohol.

Turmeric (curcumin) is the yellow coloring matter (dye) obtained from the rhizomes of *Curcuma longa.*

It is not exported from the Philippines at the present time. The value of the importations into the United States in 1907 was 26,252 dollars, the greater part being from Burma.

Curcuma longa resembles *Curcuma zedoaria,* but its flowering shoot is borne within the tuft of leaves and not directly from the rootstock as is that of *Curcuma zedoaria.* It has 5 or 6 thin, smooth, pale-green, pointed leaves, which are about 45 centimeters long and 12 to 18 centimeters wide. The flowering spike is 12 to 20 centimeters long and borne on a stalk of about the same length. The bracts are 2 to 3 centimeters long, spreading, recurved, pale green, the terminal one sometimes rosy.

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* Bacon, R. F., Philippine terpenes and essential oils, IV. Philippine Journal of Science, Section A, Volume 5 (1910), page 262.

This species is distributed from northern Luzon to Mindanao, and is locally abundant in the settled areas. *Curcuma longa* is commonly cultivated and the wild plants are probably descendants of planted ones.

CURCUMA ZEDOARIA Bosc. BARÁK or ZEDOARY.

Local names: *Alimpuyíng* (Negros Oriental); *barák* (Bataan, Mindoro); *ganda* (Zambales); *koniko* (Bontoc); *luyaluyáhan, tamo* (Rizal); *lampoyáng* (Guimaras Island); *tamahílan* (Camarines).

ZEDOARY OIL

The stout, fleshy, aromatic rootstocks when dry are called zedoary. The roots yield a volatile oil when distilled with water, and contain a pungent, soft resin and bitter extractive. They have an odor somewhat like that of ginger.

Watt * says that the rhizomes constitute one of the most important articles of native perfumery in India. The root is also used medicinally. According to the nineteenth edition of the United States Dispensatory, zedoary is a warm, stimulating aromatic, serviceable in flatulent colic and debility of the digestive organs, but is now little used, as it produces no effect which cannot be as well or better obtained from ginger.

Bacon †, found that 160 kilograms of rhizomes when chopped and steam-distilled gave 400 grams (0.25 per cent) of a light yellow oil which had the following properties:—Specific gravity, $\frac{30^\circ}{4^\circ} = 0.993$; refractive index, $N\frac{30^\circ}{D} = 1.5070$; optical rotation, $A\frac{30^\circ}{D} = 1^\circ.10$; saponification number, 2; soluble in two or more volumes of 80 per cent alcohol. This oil was distilled *in vacuo* (7 millimeters) and the distillate separated into fractions. Fraction 4, (140° to 160°) and fraction 5, (160° to 166°), gave 131 grams of oil which solidified to a beautiful white, crystalline compound, which Bacon thought was probably a sesquiterpene alcohol.

Curcuma zedoaria is an erect herb with a stout, fleshy, aromatic rootstock. The leaves usually grow in pairs and are green, often with a purplish blotch in the center. They are from 25 to 70 centimeters long and 8 to 15 centimeters wide. The flower stalks spring directly from the rootstocks and not from the leaf tuft, and often appear before the leaves. The spike is cylindrical, 5 to 8 centimeters in diameter and 10 to 15 centimeters long, and is composed of numerous somewhat spreading, rounded bracts, the lower of which are green and more or less tipped with pink, the upper ones usually longer and purple, each containing several flowers, of which the lower open first. The corolla tube is about 2 centimeters long, yellowish-white, sometimes tinged with purple.

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* Watt, The commercial products of India, 1908.

† Bacon, R. F., Philippine terpenes and essential oils, IV. Philippine Journal of Science, Section A, Volume 5 (1910), page 261.

This species is probably a native of India, but is now widely distributed in the warmer parts of the eastern hemisphere. It is common and widely distributed in thickets and open places in the settled parts of the Philippines.

Genus ZINGIBER

ZINGIBER OFFICINALE Bosc. GINGER.

Local names: *Agát* (Pangasinan); *gengibre* (Spanish); *láya* (Pampanga); *layá* (Abra, Ilocos Norte and Sur, Capiz, Iloilo); *la-yá* or *lay-á* (Zambales, Camarines, Albay, Sorsogon); *lúya* (Tarlac, Bulacan, Bataan, Rizal, Laguna, Manila, Batangas, Tayabas, Mindoro, Marinduque); *luy-á* (Albay, Iloilo, Occidental Negros, Misamis, Cuyo Islands).

GINGER

Zingiber officinale is cultivated in all parts of the Philippines, but never on a large scale, and is not exported. The dried root of this plant has a pungent, aromatic odor and is commonly known as ginger. Ginger is used as a condiment and as a flavoring agent. It is also employed medicinally as an aromatic stimulant and carminative, and is given in cases of dyspepsia and flatulent colic. It is utilized in the manufacture of ginger beer and ginger ale and also as a spice and a confection.

Ginger consists essentially of a volatile oil, a resin, and starch. Its pungency is due to the resin it contains, while the aroma is given by the volatile oil. An analysis of Calcutta ginger quoted by Leach * gave the following results:

Water	9.60
Ash	7.02
Volatile oil	2.27
Fixed oil and resin	4.58
Starch	49.34
Crude fibre	7.45
Albuminoids	6.30
Undetermined	13.44
Nitrogen	1.01

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* Leach, A. E., Food inspection and analysis (1914), page 446.

Oil of ginger is obtained by distilling the ginger root. It has a greenish-yellow color and is very aromatic though not pungent. It is slightly soluble in alcohol.

Ginger oil, and also the alcoholic extract of ginger roots, are used for flavoring beverages.

Bacon [*] distilled two lots of Philippine ginger roots and examined the distillates. He describes his results as follows:

> * * * I made two experiments on the distillation of native ginger roots. In the first one, 50 kilos of the chopped roots gave only 25 grams of oil. For the second, 132 kilos were purchased in the market at Malabon at 22 centavos, (11 cents United States currency) per kilo and immediately distilled. There were obtained 95 grams (0.072 per cent) of a light yellow oil, having the odor of ginger and also a strong smell, much like that of orange-peel oil.
>
> This oil had the following properties:
>
> Specific gravity $\frac{30^\circ}{30^\circ}=0.8850$.
>
> Refractive index, $N\frac{30^\circ}{D}=1.4830$.
>
> Optical rotation, $A\frac{30^\circ}{D}=-5.^\circ 9$.[†]
>
> Saponification number, 14.
>
> It is easily and completely soluble in two or more volumes of 90 per cent alcohol.
>
> It is seen that oil from the Philippine ginger differs quite markedly in its properties from that distilled from the Jamaica or African varieties and resembles some Japanese oils examined by Schimmel and Company in its ready solubility in 90 per cent alcohol, and its negative optical rotation.

Family MAGNOLIACEAE

Genus MICHELIA

MICHELIA CHAMPACA L. (Fig. 60). **CHAMPÁKA.**

Local names: *Champákang-pulá* (Manila); *sampáka* (Rizal).

CHAMPÁKA OIL

Oil obtained from the flowers of this species is used as a perfume.

Roure-Bertrand Fils [‡] state in their bulletin that the perfume of Philippine champaka flowers is stronger and sweeter than that of the flowers obtained from Singapore, Penang or Colombo.

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[*] Bacon, R. F., Philippine terpenes and essential oils, IV. Philippine Journal of Science, Section A, Volume 5 (1910), page 259.

[†] In the original, the minus sign is omitted, apparently through error, since Bacon says, in the body of the paper, that the oil has a negative rotation.

[‡] Bulletin of Roure-Bertrand Fils, Volume 1 (1909), page 26.

In experimenting with champaka flowers it is necessary to work rapidly because a few hours after picking, the flowers turn brown and begin to lose their fragrance. The oil obtained from these flowers has been investigated by Bacon [*] and by Brooks.[†] According to Bacon:

> The yield appears to be over 0.2 per cent. The crude oil on standing separated a large amount of a crystalline solid. This was filtered and an additional quantity of it was again separated by the addition of ether, in which the solid is quite insoluble. The remaining oil, after standing for some weeks in the laboratory, continued to solidify until it gradually became semisolid. The second solid which separated was amorphous and appeared to be resinous in nature. If this semisolid extract is treated with 70 per cent alcohol, about half of it separates in the form of the amorphous, brown, odorless body. This was filtered and the filtrate concentrated at 40° *in vacuo* until a brown oil separated, which had a very fine odor of champaca, and was readily soluble in 70 per cent alcohol or stronger. Our oil had the following constants: Specific gravity, $\frac{30^\circ}{30^\circ}$, 0.9543; refractive index, $N\frac{30^\circ}{D}$, 1.4550; saponification number, 160. Another oil had specific gravity, $\frac{30^\circ}{30^\circ}$, 1.020; refractive index, $N\frac{30^\circ}{D}$, 1.4830; saponification number, 180. The second oil had the finer odor. The oils were too dark to permit of determinations of the optical activity. * * *
>
> Fifty grams of champaka oil (soluble in 70 per cent alcohol, ester number 180) were saponified with 10 grams potassium hydrate in 100 cubic centimeters of 95 per cent alcohol. After heating for one hour with a reflux condenser, two volumes of water were added; 4.5 grams of an amorphous solid separated. This was filtered and the filtrate was separated into neutral, acid, and phenol fractions. By saponification the champaka oil loses all of its characteristic odor, which therefore must be due to esters.
>
> The phenol fraction (1.5 grams) proved to consist principally of iso-eugenol, as benzoyl iso-eugenol melting at 103° could be obtained from it. The total acid fraction weighed 15 grams. None of this acid boils below 140° at 40 millimeters; hence there is no methyl ethyl acetic acid. No acids have as yet been identified.
>
> The neutral portion weighed 23 grams and had an odor somewhat similar to that of oil of bay.

Bacon found that the solid which crystallizes from the freshly prepared oil, after repeated crystallization from benzene and petroleum ether, forms odorless, white crystals.

Brooks examined two samples of champaka oil and obtained the constants recorded in Table 29.

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[*] Bacon, R. F., Philippine terpenes and essential oils, III, Philippine Journal of Science, Section A, Volume 4 (1909), page 131; IV, Volume 5 (1910), page 262.

[†] Brooks, B. T., New Philippine essential oils. Philippine Journal of Science, Section A, Volume 6 (1911), page 333.

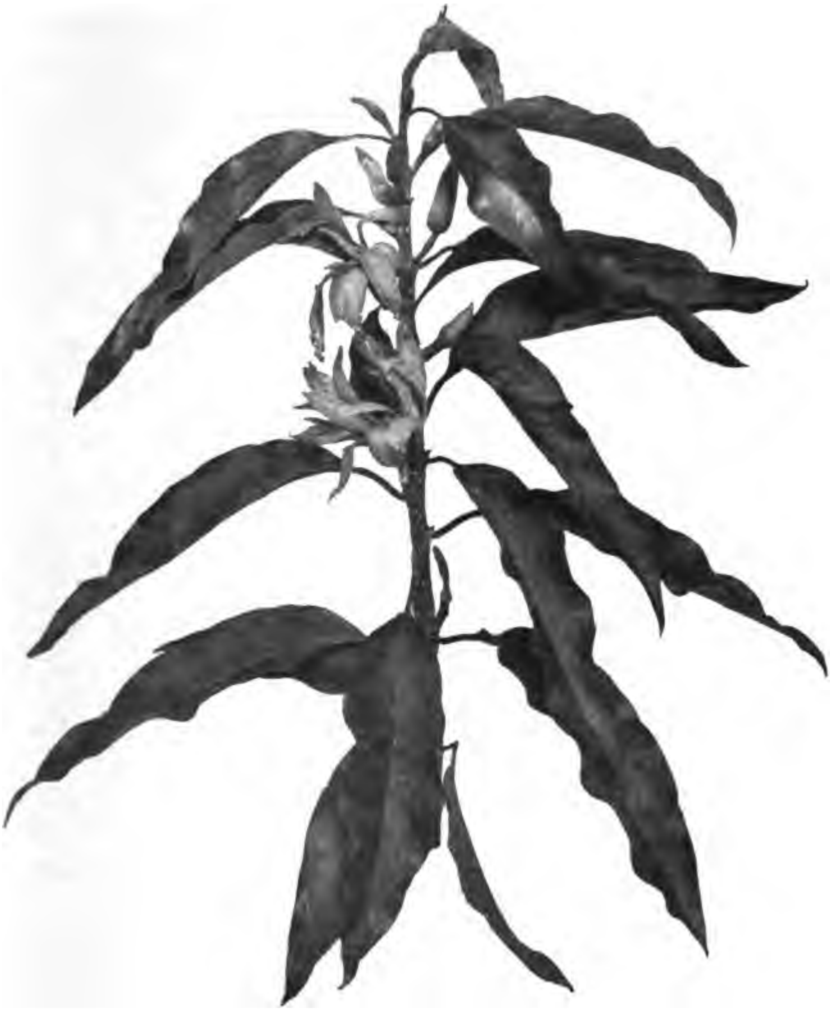

FIGURE 60. MICHELIA CHAMPACA (CHAMPAKA), THE SOURCE OF CHAMPACA OIL.

TABLE 29.—*Constants of champaka oil.*

Constants.	Specimen No.	
	I.	II.
Specific gravity $\frac{30^\circ}{30^\circ}$	0.904	0.9107
Refractive index $N^{30^\circ}_{D}$	1.4640	1.4688
Ester number	124	146
Ester number after acetylating	------------	199

According to Brooks, when champaka oil is heated, a large part of it is polymerized to resin. The oil obtained by steam-distilling consists largely of cineol. The solid which crystallizes from the freshly prepared oil is probably a ketone compound. In addition to iso-eugenol, the essential oil of yellow champaka flowers contains benzoic acid, benzyl alcohol, benzaldehyde, cineol, and p-cresol methyl ether.

Michelia champaca is a small tree with spear-shaped leaves, 12 to 20 centimeters long and 2.5 to 6 centimeters wide. The flowers are yellowish brown, very fragrant, and from 4 to 5 centimeters in length. They are highly prized by the Filipinos and by them are made into necklaces.

MICHELIA LONGIFLORA Blume. CHAMPÁKANG-PUTÍ.

CHAMPÁKANG-PUTÍ OIL

Champaka oil obtained from this species has been exported to Europe from Java. According to Brooks * the purified oil is dark green in color. It possesses an intensely sweet, almost nauseating odor, which is very different from that of the oil obtained from the flowers of *Michelia champaca*.

The constants of the oil are as follows: Specific gravity, 0.897; ester number, 180.0; refractive index, $N\frac{30^\circ}{D}=1.4470$. The above constants point to a rather large per cent of the esters of fatty acids. According to Brooks the oil contains linaloöl, methyl eugenol, methyl-ethyl-acetic acid, and acetic acid. The odor of the oil is chiefly that of the methyl or ethyl ester of methyl-ethyl-acetic acid.

Michelia longiflora is a small tree with white flowers. It is a native of Java and is occasionally cultivated in Manila.

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* Brooks, B. T., New Philippine essential oils. Philippine Journal of Science, Volume 6 (1911), page 333.

Family ANNONACEAE

Genus CANANGIUM

CANANGIUM ODORATUM (Lam.) Baill. (Figs. 61–62). ILANG-ÍLANG.

Local names: *Alañgigan* (Ilocos Norte and Sur, Abra, Lepanto); *alañgilan* (Mindoro); *anañgilan* (Surigao); *anañgiran* (Manobo); *búrak* (Leyte); *ilang-ílang* (Ilocos Sur, Zambales, Tayabas, Bataan, Rizal, Manila, Laguna, Mindoro, Balabac Island, Masbate, Guimaras Island, Ticao Island, Davao, Surigao); *tañgíd, tañgít* (Camarines, Albay, Sorsogon).

ILANG-ÍLANG OIL

Ilang-ilang * oil is obtained by steam-distilling the flowers of *Canangium odoratum,* in perfume literature sometimes called "the flower of flowers." The best grade of distilled oil is almost colorless, having only a slight yellow tint. The inferior grades are greenish yellow. A very high-grade oil is also obtained by extracting the flowers with petroleum ether. This oil usually appears very dark.

Ilang-ilang oil is extensively used in the perfumery industry. It is employed in the preparation of high grade perfumes such as lily of the valley, corylopsis, etc.

Askinson † gives the formulas of various perfumes containing ilang-ilang as one of the principal constituents. The formula of one of these perfumes is as follows:

Heliotrope

Oil of ylang-ylang	drops	20
Geraniol	do	10
Benzaldehyde	do	2
Heliotropin	grains	35
Vanillin	do	6
Coumarin	do	4
Tincture of musk (xylene 100%)	do	40
Cologne spirit (95%) enough to make	quart	1

The manufacture of ilang-ilang oil is the most important, in fact, it is practically the only perfume industry in the Philippines. This oil is peculiarly a product of the Philippines. According to Parry ‡ oil distilled in other tropical countries from the same tree is not ranked in the same class as the Philippine product as regards quality. The value and amount of ilang-ilang exported from the Philippine Islands for the last four years are given in Table 30.

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* Frequently spelled ylang-ylang.

† Askinson, G. W., Perfumes and cosmetics, (1915).

‡ Parry, E. J., Chemistry of essential oils and artificial perfumes, (1908).

TABLE 30.—*Amount and value of ilang-ilang oil exported from the Philippine Islands.*

Year.	Amount.	Value.
	Kilograms.	*Pesos.*
1915	1,277	43,514
1916	975	75,032
1917	2,286	93,951
1918	476	65,595

MANUFACTURE OF OIL

The flowers are usually picked at night and are collected in the morning by the people who deliver them at the distilleries. In Manila the best flowers are usually obtained in May and June. We have little information as to the yield of flowers produced by a single tree, but it is apparently large.

Bacon,* who made an extensive investigation of ilang-ilang oil, did not believe that the distillation offered any special difficulties, but that it was necessary to collect only the proper fraction. He found that when the flowers are distilled commercially the procedure is frequently not carried out in the proper manner and that consequently a low grade of oil is often obtained.

> * * * The important points where many err, and this is especially true of the provincial distillers, is in the wrong choice of fractions, in burning the flowers and in obtaining too much resin in the oil. The oil must be distilled slowly, with *clean steam,* the flowers being so placed in the stills as to avoid their being cut into channels by the steam. The quantity of the oil taken is only a fraction of the total amount in the flowers. Disregard of this factor is one of the most grievous errors of the provincial distillers, for, on the contrary, they are usually too anxious to obtain a large yield of oil, and therefore they will often distill 1 kilo from 150 to 200 kilos of flowers. The quantity of the latter to be taken to produce 1 kilo of oil naturally varies with their quality, but in general the amount should be 300 to 500 kilos, probably averaging about 400. After the first quality oil has been distilled, then a varying quantity of the second grade, up to a volume equal to that of the first, may be obtained from the same lot of flowers; after this operation the still and condensers must be thoroughly cleaned and steamed out to prevent contamination of

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* Bacon, R. F., Philippine terpenes and essential oils, II. Ylang-ylang oil. Philippine Journal of Science, Section A, Volume 3 (1908), page 65.

Bacon, R. F., Philippine terpenes and essential oils, III. Oil of Ylang-ylang. Philippine Journal of Science, Section A, Volume 4 (1909), page 127.

Bacon, R. F., Philippine terpenes and essential oils, IV. Oil of Ylang-ylang. Philippine Journal of Science, Section A, Volume 5 (1910), page 265.

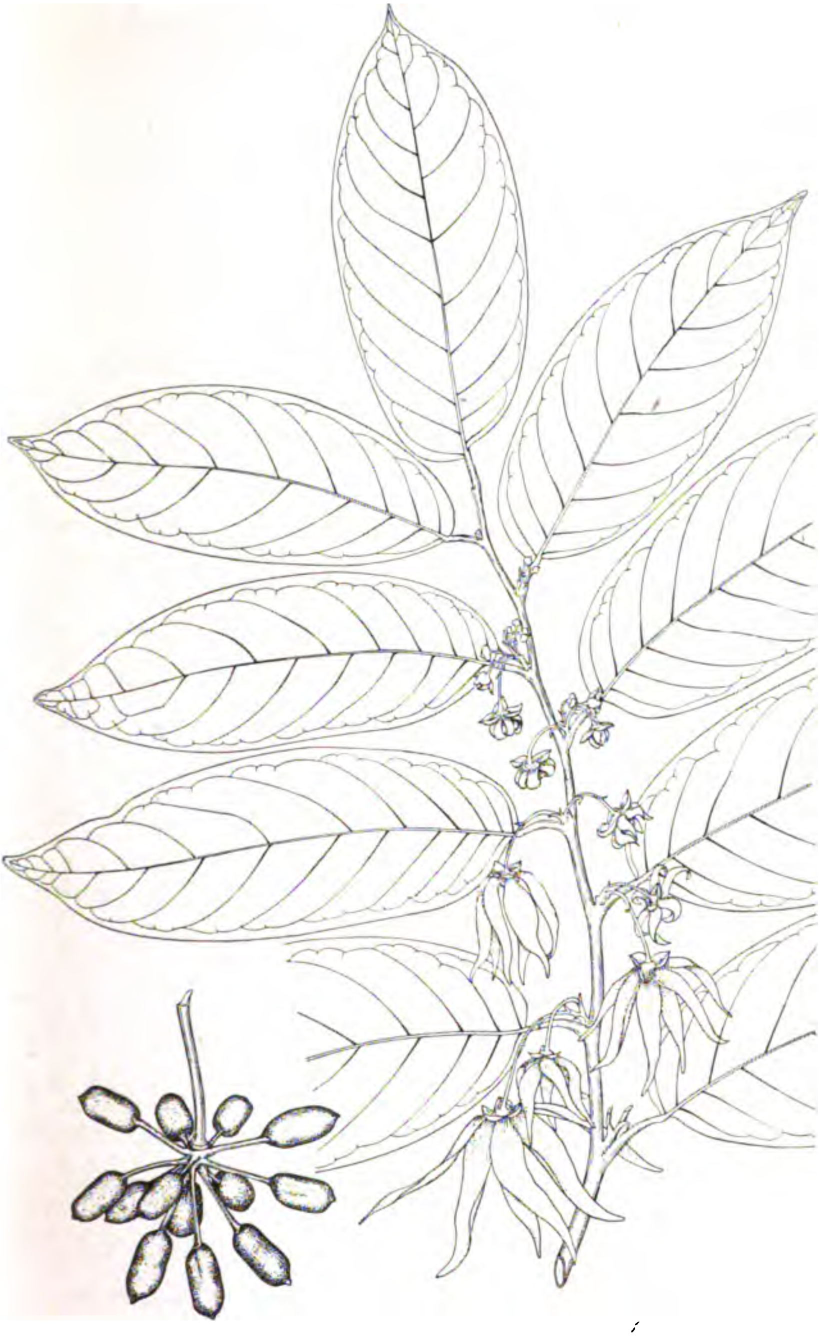

FIGURE 61. CANANGIUM ODORATUM (ILANG-ILANG), THE SOURCE OF ILANG-ILANG OIL. ×½.

> the next distillation of first quality oil with the remains of the second quality adhering to the apparatus. The distiller usually judges of the time to change the receptacle from that used for first quality to that employed for the second, by taking note of the odor of the distillate. The oil is received in some type of Florence flask, usually two or more of these are connected in series and the condensed water is used in future distillations. The whole apparatus is best lined with block tin, although some distillers have found nickel to be more satisfactory. The oil, after separating from the water, is clarified and as it is sensitive to light and air, it should be placed into dark colored bottles as soon as possible; these should be filled to the neck, well stoppered and then paraffined to keep out all air. In the ideal apparatus the receivers should be so constructed that very little light and air has access to the oil. * * *

Bacon emphasized the fact that only mature, yellow flowers should be used, and he believed that the greatest advance in the industry would take place when the distillers owned their own groves and could select their flowers. This is shown very strikingly in the following quotation:

> Fifty-four and five-tenths kilos (120 pounds) of extra fine flowers, one-half of which were perfectly yellow and ripe, were distilled with steam in the usual manner and the following fractions were obtained:
>
> Number 1: 55 cubic centimeters; specific gravity, $\frac{30^\circ}{4^\circ}=0.960$; $A\frac{30^\circ}{D}=-19.8^\circ$; $N\frac{30^\circ}{D}=1.4865$; ester number, 178.
>
> Number 2: 33 cubic centimeters; specific gravity, $\frac{30^\circ}{4^\circ}=0.959$; $A\frac{30^\circ}{D}=-26.5^\circ$; $N\frac{30^\circ}{D}=1.4914$; ester number, 160.
>
> Number 3: 90 cubic centimeters; specific gravity, $\frac{30^\circ}{4^\circ}=0.954$; $A\frac{30^\circ}{D}=-34.6^\circ$; $N\frac{30^\circ}{D}=1.4956$; ester number, 154.
>
> Number 4: 80 cubic centimeters; specific gravity, $\frac{30^\circ}{4^\circ}=0.942$; $A\frac{30^\circ}{D}=-53.4^\circ$; $N\frac{30^\circ}{D}=1.5020$; ester number, 113.
>
> Tubes numbers 1, 2 and 3 united gave the following constants: Specific gravity, $\frac{30^\circ}{4^\circ}=0.958$; $A\frac{30^\circ}{D}=-27.0$; $N\frac{30^\circ}{D}=1.4910$; ester number, 169.
>
> The total oil obtained was 258 cubic centimeters, which is 264 grams, corresponding to a yield of 0.45 per cent.
>
> This yield was nearly twice the normal amount and the quality of the oil was very high, as was shown not only by analytical figures given above, but also was confirmed by the opinions of Manila experts to whom it was submitted.
>
> I believe these experiments indicate that 200 kilos of ripe, yellow flowers will give 1 kilo of a better quality of oil than will 400 kilos of the class of poor, mixed flowers used at the present time. It is a well-known fact of plant physiology that the odoriferous substance is present in the flowers in greatest abundance and in finest quality at the time when it is mature

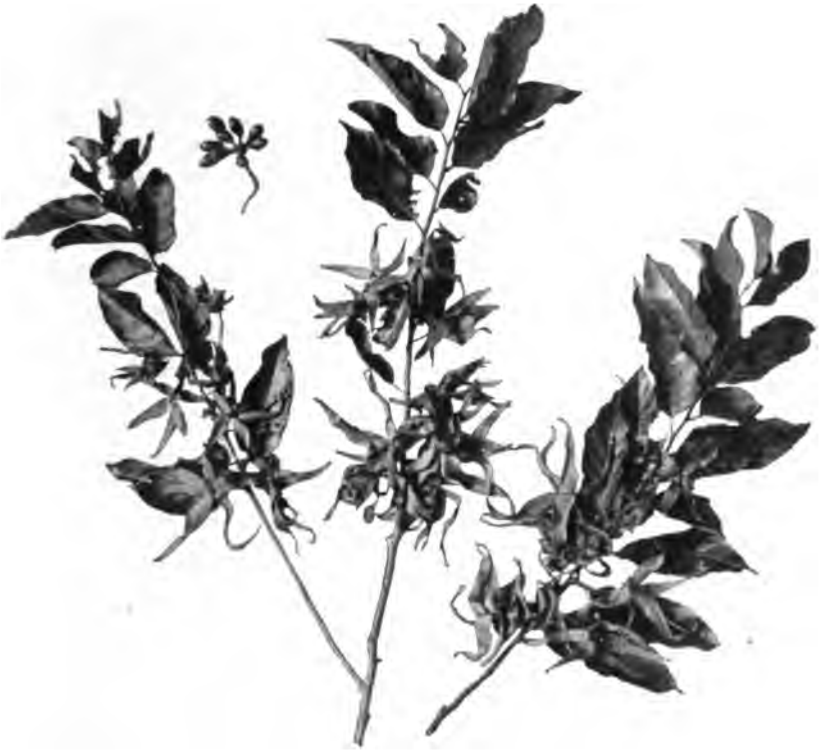

FIGURE 62. CANANGIUM ODORATUM (ILANG-ILANG), THE SOURCE OF ILANG-ILANG OIL.

and ready for pollination. No doubt, in the course of time much can be done toward improving the yield and quality of ilang-ilang oil by intelligent plant selection. Such work requires much patience and at present there are absolutely no data available save a general opinion that the ilang-ilang trees of the wild mountain regions are not as fragrant as the cultivated ones of the lowlands.

CLASSIFICATION OF ILANG-ILANG OIL

It is a well-known fact that ilang-ilang oil, like many other natural perfumes, does not owe its fragrance to any one substance, but is a mixture of a number of odoriferous compounds. It is generally bought and sold on the judgment of the dealers, the determining factor being the odor. Obviously the judgment of various buyers may differ, and consequently it is desirable, if possible, to value the oil according to analytical tests, so that the purchase and sale may be placed upon an exact analytical basis.

Bacon obtained a number of samples of ilang-ilang oil, mostly from one distillery, the process of distillation being watched and the samples collected by himself. He determined a few of the simple constants of these oils, such as specific gravity (pyknometer), optical rotation, refractive index, and ester number; the latter by the usual method, using 1 gram of oil. A few of these results are recorded in Table 31.

TABLE 31.—*Tabulation of the constants of ilang-ilang oils.*

Grade.	Sample.	Sp. gr. $\frac{30^\circ}{4^\circ}$.	a $\frac{30^\circ}{D.}$	n $\frac{30^\circ}{D.}$	Ester number.	Origin and remarks.
First	5	0.939	—34.2	1.4880	131	B.'s distillate of August 22, 1907.
	10	0.922	—26.0	1.4794	117	First quality oil rectified *in vacuo*. B.'s distillate 90 per cent yield.
	21	0.949	—36.1	1.4940	138	Distilled *in vacuo* with steam from selected flowers.
	22	0.827	—42.2	1.4912	126	B.'s distillate of Febuary 1, 1908, from very good flowers.
	23	0.958	—27.0	1.4910	169	0.4 per cent yield from selected flowers with very careful distillation. A very fine oil.
Second	12	0.917	—66.7	1.5032	70	Distillation of second-quality oil from flowers from which the first quality had been previously distilled. Yield, 0.7 per cent.
	13	0.919	—61.4	1.4977	86	Second-quality oil.
	14	0.918	—66.4	1.4986	83	Second-quality oil.
	15	0.903	—81.8	1.4981	59	Second-quality oil.
	16	0.928	—80.2	1.4927	64	Provincial oil.

The determination of these constants enables us to classify oils into first and second grades. The limits for these grades are given in Table 32.

TABLE 32.—*Classification of ilang-ilang oil according to Bacon.*

Constants.	First grade.	Second grade.
Ester number	100 and above	80 to 100.
Index of refraction	1.4900 and below	Above 1.4900.
Specific rotation	−45° and below	Above−45°.

In a later publication Bacon showed that first-grade oils have a higher acetyl number than second-grade oils.

The classification of ilang-ilang oil now in use is a modification of Bacon's standard of classification, which was proposed by Dr. Jaehrling of the firm of Santos and Jaehrling of Manila, and advocated by Gibbs.* The constants of this classification are given in Table 33. This classification divides Bacon's first class into three divisions, namely: extra, 1–a, and 1–b. This division is apparently necessary on account of the large proportion of high-grade oil which is now produced.

TABLE 33.—*Classification of ilang-ilang oil according to Jaehrling.*

Grade.	Ester number.	Index of refraction.	Specific rotation.	Solubility in alcohol of—
				Per cent.
Extra	Above 145	Below 1.4900	Above−35	80.
1a	120 to 145	1.4900 to 1.4950	−35 to−48	90.
1b	100 to 120	1.4950 to 1.4990	−48 to−60	90-96.
2	Below 100	Above 1.4990	Below−60	96

The solubility of ilang-ilang in alcohol is also given as an extra test. According to Gibbs, this is very useful as a confirmatory test, since it indicates the amount of sesquiterpenes present in the oil. This test consists in determining the lowest strength of aqueous alcohol which can be mixed with the oil without cloudiness, in the proportion of 2 of oil to 1 of alcohol.

Bacon suggests an easy method of judging approximately the quality of an oil:

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* Gibbs, H. D., Proposed modification of ilang-ilang oil standards. Philippine Journal of Science, Section A, Volume 10 (1915), page 99.

> * * * To prepare a 1 per cent solution of the oil in alcohol and compare the odor with a similar one of an oil of known quality, as judgment is much more certain as to the perfuming power when dilute solutions instead of the pure oils are used. One cubic centimeter of each solution can then be poured on separated pieces of bibulous paper, the odor being compared at the end of twelve, twenty-four, or even a longer number of hours; this test gives some idea in regard to the permanence of the odor.

DISTILLATION OF OIL IN VACUO

Bacon found that the distillation of the oil *in vacuo* provides a good method of ascertaining the quality of an oil and the number of flowers used in preparing it. He also showed that the rectification of oils *in vacuo* is not very successful. These points are shown in the following quotation:

> * * * the rectification of oils *in vacuo* is not an entire success, as the distillates, although apparently of the same composition as the oil from which they are distilled, seem to lack in perfuming power; this is especially true of the lasting qualities of the odor. These results suggest that the highest boiling parts of the ilang-ilang oil and even the resins, are very probably important constituents of the whole, possibly they help to fix the more volatile, odoriferous portions. I have always been impressed by the peculiarly lasting fragrance of the resinous residues of the distillation of ilang-ilang oils fractioned *in vacuo*.
>
> The distillation of ilang-ilang oils *in vacuo* has shown that over 50 per cent of the first quality oil will pass over below 100° at 10 millimeters pressure, and when I have tested poorer oils in this respect I have found the amount of substance volatile below 100° at 10 millimeters which passed over to be proportional to the quantity of flowers used in preparing the oil. Thus one oil distilled from flowers at the yield of 1 kilo for 206 kilos of flowers showed 27 per cent of volatile constituents under the conditions named, whereas another prepared in the proportion of 1 kilo to 150 kilos of flowers gave 19 per cent.
>
> It follows from this that the distillation test is also of value both in determining the quality of an oil and the proportion of flowers used in preparing it. The only manner in which poor provincial oils may be improved is by redistillation with steam, and this procedure results in large losses. Fractioning with steam *in vacuo* also seems quite promising, although the process is very slow. Oils thus obtained are quite colorless, and by taking suitable fractions a very fair oil may thus be prepared from a product which before treatment was almost unsalable.

EXTRACTION OF PERFUME OIL WITH SOLVENTS

Bacon * also studied the problem of extracting the oil from ilang-ilang flowers with solvents:

> * * * Many of the constituents of essential oils are very delicate substances and distillation with steam decomposes these compounds to a

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* Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), page 129.

considerable extent, so that a steam-distilled oil but rarely has exactly the same odor as the flowers from which it was obtained. Extraction with cold solvents and the removal of the solvent *in vacuo*, the temperature never being allowed to rise above 40°, gives oils which have exactly the same aroma as the flowers. This process has the further commercial advantage that such extracted flower oils can not be imitated synthetically, as the change in aroma is undoubtedly due to traces of very easily decomposable compounds which it will be difficult, if not impossible, ever to isolate and identify. The extracted oil need fear no competition with synthetic oils. Alcohol, ether, chloroform and petroleum ether have been used as solvents for ilang-ilang oil, and the last named has given the best results. Naturally, a very high grade of petroleum ether, which leaves no bad smelling residue when distilled up to 40° in a vacuum of 40 millimeters, must be used as the solvent for the essential oil. Operating in this manner, we have obtained oil yields of from 0.7 to 1.0 per cent. The oil is of a very dark color and contains a considerable amount of resin in solution. When in bulk, the odor is not particularly pleasant or very strong, but when the extract is greatly diluted the pleasant aroma of the flowers becomes very apparent. The physical constants of one sample of this oil were as follows: Specific gravity, $\frac{30^\circ}{4^\circ}=0.940$; $N\frac{30^\circ}{D}=1.4920$; ester number 135; acetyl number 208.

The oil is too dark to permit readings of its optical rotation to be practicable. These constants are seen to agree quite well with those of a very high grade distilled oil, and as was stated above, the different odor is probably due to traces of delicate compounds present in the extracted oil, which are destroyed during the process of distillation. It is rather curious to note that when this extracted oil is shaken out with water, a considerable amount of resin separates, carrying the distinctive flower aroma, and the separated oil then has an odor resembling that of methyl-*p*-kresol.

These extracted oils should sell for a considerably higher price than the best distilled oils, which fact, taken in consideration with the increased yield and the impossibility of competition from synthetic oils, offers a very attractive new industry to the Philippines.

ADULTERANTS

Regarding the use of adulterants of ilang-ilang oil, Bacon says that he does not believe the practice is very general in the Philippines. The common adulterants are said to be turpentine, coconut or other fixed oils, and kerosene. Bacon suggests various tests for these substances, if their presence is suspected.*

The use of any adulteration is more emphatically the height of commercial folly for ilang-ilang than it is for any other essential oil, for only the product of the highest quality brings a remunerative price. A 10 per cent increase in quantity by means of adulteration may cut the price in two, or may result in an oil which can not be sold at any price. * * *

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* Bacon, R. F., Philippine terpenes and essential oils, II. Ylang-ylang oil. Philippine Journal of Science, Section A, Volume 3 (1908), page 76.

COMPOSITION OF ILANG-ILANG OIL

Parry states that investigations of ilang-ilang oil have shown that it contains esters of benzoic and acetic acids, also linaloöl, cadinene, pinene, P-cresol methyl ether, geraniol, and iso-eugenol. Parry is of the opinion that in addition to these substances, ilang-ilang contains other compounds, as a synthetic oil closely resembling the natural oil has been prepared commercially. Probably a considerable amount of research has been done on ilang-ilang, but for trade reasons the investigators do not care to publish their results.

Bacon * performed a number of experiments to determine the composition of ilang-ilang oil and concluded that it contained formic, acetic, valerianic (?), benzoic, and salicylic acids, all as esters; methyl and benzyl alcohols; pinene and other terpenes, linaloöl, geraniol, safrol, cadinene and other sesquiterpenes; eugenol, iso-eugenol, p-cresol, probably as methyl ethers; and cresol. He then prepared a synthetic oil in order to test the accuracy of his studies on the composition of ilang-ilang oil. His synthetic ilang-ilang contained the following substances (proportions not stated): methyl benzoate; benzyl acetate and formate; benzyl methyl ether (trace); benzyl valerianate (trace); methyl salicylate; benzyl benzoate; cadinene; safrol; iso-eugenol-methyl ether; eugenol; cresol; methyl anthranilate (trace); p-cresol-methyl ether; p-cresol acetate. This mixture gave an odor very similar to good ilang-ilang oil. From the results of his own work and that of others Bacon concluded:

> * * * ylang-ylang oil has a composite odor, derived from that of many constituents. While it is possible to make a very good artificial ylang-ylang oil, I do not believe that distillers of the best quality of ylang-ylang oil have much to fear from this competition, as the odor of a first-class oil seems to have more permanence than that of the artificial product. This is a result, I believe, of the presence of sesquiterpene alcohols and fragrant resins in the former.

GROWTH OF CANANGIUM ODORATUM

This species has been grown in plantations at Los Baños. Only one lot of seeds was planted, and this showed a very low percentage of germination, 3.2 per cent. It is uncertain as to whether or not this low percentage was due to poor seed. The trees have done well in plantations. The average rates of growth of considerable numbers are given in Table 34.

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* Bacon, R. F., Philippine terpenes and essential oils, II. Ylang-ylang oil. Philippine Journal of Science, Section A, Volume 3 (1908), page 86.

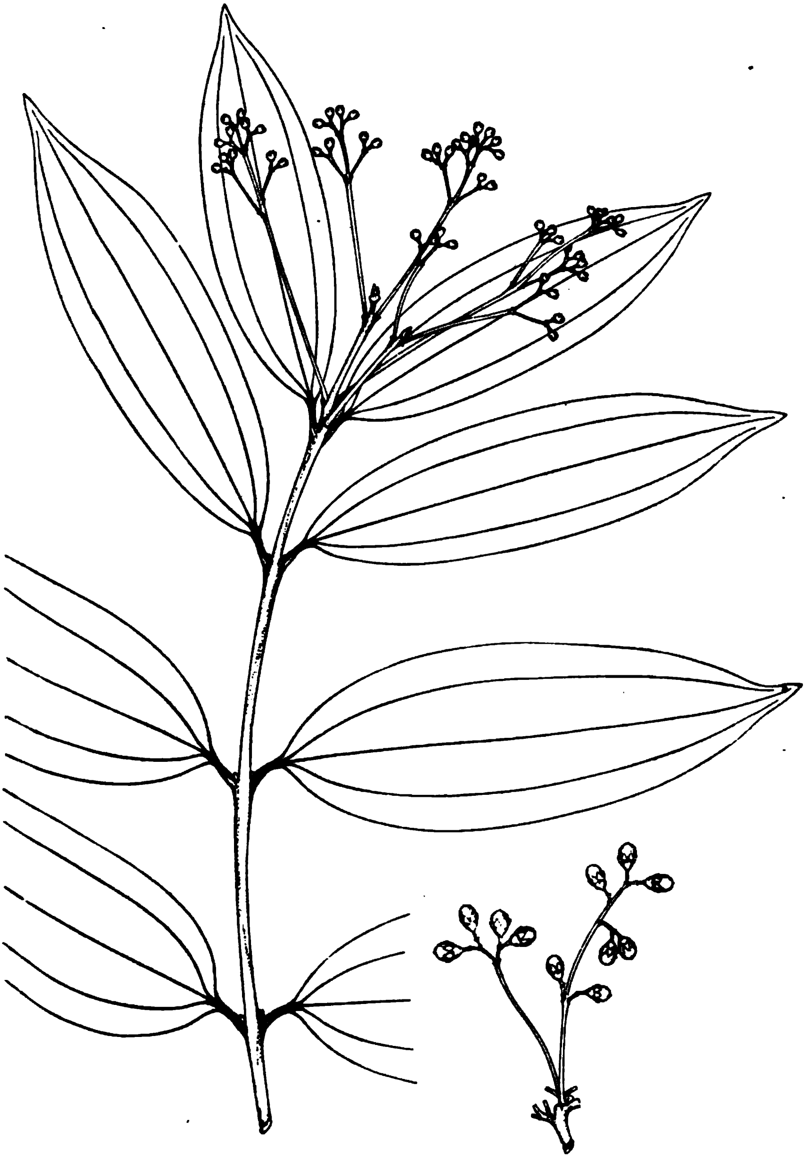

FIGURE 63. CINNAMOMUM INERS, A SOURCE OF CINNAMON. ×½.

TABLE 34.—*Growth of Canangium odoratum (Ilang-ilang) in plantations at Los Baños, Laguna.*

Age.	Diameter.	Height.
Years.	*cm.*	*m.*
2		1.33
3		2.05
4		3.80
5	7	5.34
7	12	8.35

Canangium odoratum is a medium-sized to rather large tree, with somewhat drooping branches. The leaves are alternate, 12 to 20 centimeters long, pointed at the apex, and usually rounded at the base. The flowers are very fragrant, greenish, soon turning yellowish, pendulous. The pedicels are 1 to 2.5 centimeters long and elongated in fruit. The sepals are hairy. The petals are somewhat hairy, narrow, pointed, 4 to 6 centimeters long and 0.5 to 1 centimeter wide.

This species is a native of the Philippines and is found throughout the Archipelago both cultivated and wild. It occurs at elevations of at least 700 meters. It is very commonly cultivated in Manila and flowers throughout the year.

Family LAURACEAE

Genus CINNAMOMUM

CINNAMOMUM INERS Reinw. (Fig. 63). CINNAMON.

Local names: *Marobo* (Samar).

CINNAMON

The bark of this species is sold commercially as cinnamon.

Cinnamomum iners is a small to large tree. The leaves are opposite, smooth, leathery, from 8 to 16 centimeters long, pointed at the apex and rounded or pointed at the base. The flowers are yellowish, about 4 millimeters long, and borne on compound inflorescences. The fruits are about a centimeter long.

This species has been reported from Mindoro, Palawan, Samar, Mindanao, and Tawi-tawi.

CINNAMOMUM MERCADOI Vid. (Fig. 64). KALÍÑGAG.

Local names: *Canela* (Span. in Pangasinan); *kalíñgag* (Rizal, Bataan, Lanao, Laguna, Samar, Tayabas, Camarines, Polillo, Pampanga); *kalíñgad* (Pampanga); *kaníla* (Lepanto, Albay); *kanilao*, *kaníñgai* (Camarines); *kandaróma* (Benguet); *kasíu* (Calayan Island); *kulíuan* or *ulíuan* (Cagayan); *samíling* (Bataan).

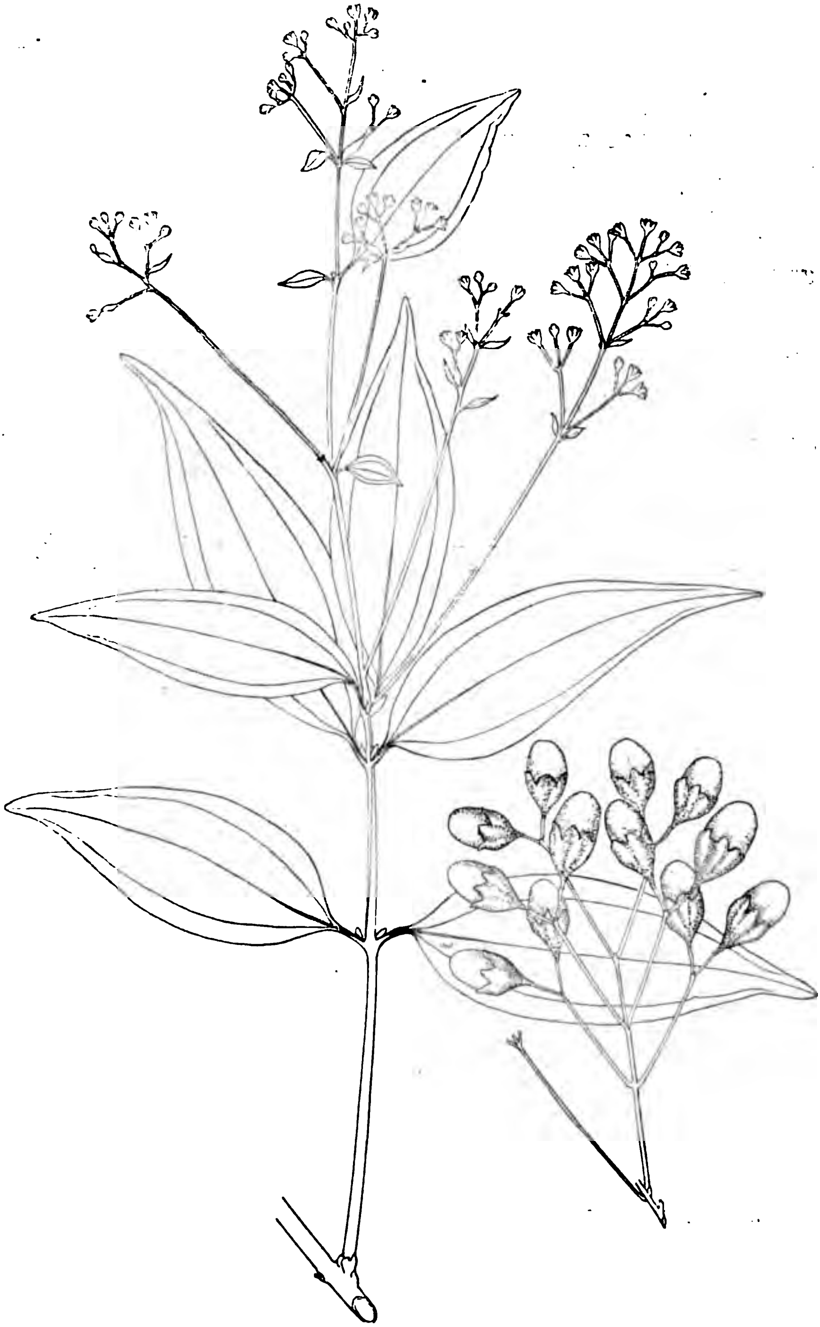

FIGURE 64. CINNAMOMUM MERCADOI (KALINGAG), THE SOURCE OF KALINGAG OIL. ×½.

KALIÑGAG OIL

The bark of *Cinnamomum mercadoi* is used locally as medicine and would probably, on account of its strong sassafras odor and taste, make a good ingredient for root beers.

Bacon * made a chemical investigation of this bark and reported his results as follows:

> * * * I obtained 25 kilos of bark from the Lamao region, Bataan Province. This bark was ground and distilled with steam, giving 260 grams (1.04 per cent) of a light yellow oil. The oil had an odor like sassafras and the following properties: Specific gravity $\frac{30^\circ}{4^\circ}=1.0461$; $N\frac{30^\circ}{D}=1.5270$; $A\frac{30^\circ}{D}=+4^\circ$. * * *
>
> The oil was distilled at 10 millimeters and gave the following fractions:
>
> | No. | Boiling point. | Quantity. | $N\frac{30^\circ}{D.}$ |
> |---|---|---|---|
> | | *Degrees.* | *Grams.* | |
> | 1 | 119-124 | 77° | 1.5333 |
> | 2 | 124-130 | 9.2 | 1.5320 |
> | 3 | Residue | 11.5 | 1.5278 |
>
> Fraction No. 1 redistilled at ordinary pressure had a boiling point 235° to 238° at 760 millimeters; specific gravity, $\frac{30^\circ}{4^\circ}=1.0631$; $N\frac{30^\circ}{D}=1.5335$; $A\frac{30^\circ}{D}=+0.9$. By oxidation with chromic acid this fraction gives piperonylic acid melting at 227°. Piperonal was obtained by heating with alcoholic potash and then oxidizing with potassium permanganate.
>
> These results leave no doubt but that the oil from *Cinnamomum mercadoi* Vid. is almost entirely safrol, and it is remarkable in this respect, as most oils from *Cinnamomum* species contain only small amounts of safrol and large percentages of cinnamic aldehyde. * * *

Cinnamomum mercadoi is a small to medium-sized tree up to 65 centimeters in diameter. It is usually straight but not very tall. The leaves are opposite, smooth, leathery, pointed at both ends, distinctly three-nerved, and from 8 to 20 centimeters in length. The fruits are about 2 centimeters long and surrounded to the middle by the persistent calyx.

This species is very widely distributed and well known, but rather scarce. Quantities of bark sufficient for commercial utilization could be collected, if it were of sufficient value.

CINNAMOMUM MINDANAENSE Elm. (Fig. 65). MINDANAO CINNAMON.

Local names: *Kaliñgag* (Surigao); *canela* (Span. in Zamboanga).

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* Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), page 114.

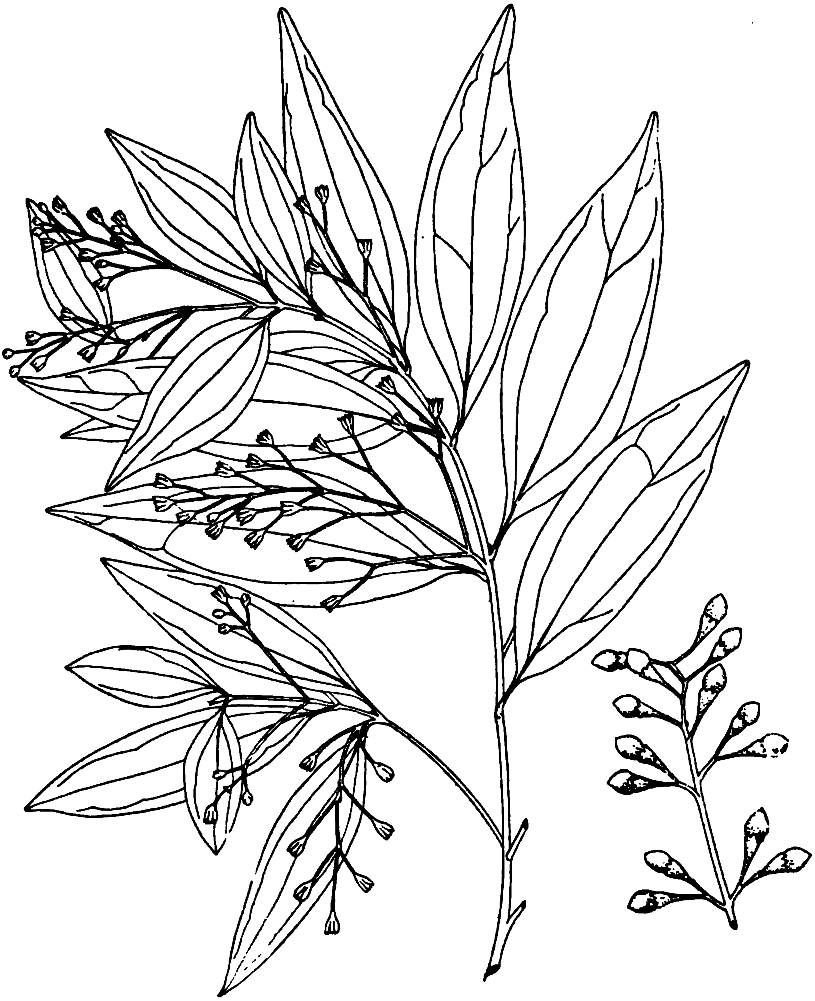

FIGURE 65. CINNAMOMUM MINDANAENSE (MINDANAO CINNAMON), A SOURCE OF CINNAMON. X½.

CINNAMON

The bark of this species is collected and sold as cinnamon of commerce.

Bacon * examined the bark, and reported as follows:

> * * * The tree is very close to *Cinnamomum zeylanicum* Nees and the bark in appearance, taste, and odor is just like the cinnamon of commerce. Fifty kilos of the ground bark were distilled with steam, yielding 200 grams of oil of a yellow color and of a strong cinnamon odor and taste.
>
> This probably does not represent by any means all of the oil which it is possible to obtain by commercial distillation from this bark, the proportion being less because of the small amount of material at my disposal. The oil had the following properties: Refractive index, $N^{30°}_{D}$ 1.5300; optical rotation, $A^{30°}_{D}$ 7°.9; specific gravity, $\frac{30°}{30}$ 0.960.
>
> Ten grams of the oil gave 9.2 grams of the dry sodium bisulphite compound of cinnamic aldehyde, corresponding to an aldehyde content of approximately 60 per cent.
>
> This oil does not agree very closely in its physical properties with the Ceylon cinnamon oil from *C. zeylanicum.*

Cinnamomum mindanaense is usually a small tree, about 10 meters in height. The leaves are opposite or sub-opposite, smooth, leathery, pointed at both ends, and from 7 to 15 centimeters in length. The flowers are greenish, about 5 millimeters long, and borne on compound inflorescences. The fruits when mature are shining steel-blue, 1.25 centimeters long, and 7.5 millimeters in width.

This species is known only from Mindanao, where it is fairly abundant in some places.

Family LEGUMINOSAE

Genus ACACIA

ACACIA FARNESIANA Willd. (Fig. 66). CASSIE FLOWER or AROMA.

CASSIE-FLOWER OIL

A gum which resembles gum arabic exudes from the bark of this tree. The flowers are known commercially as cassie flowers. *Acacia farnesiana* is grown extensively in France for the fragrant perfume obtained from the flowers. The odor of this perfume resembles that of violets, but is more intense. Piesse † states that cassie perfume is one of those fine odors which are

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* Bacon, R. F., Philippine terpenes and essential oils, IV. Philippine Journal of Science, Section A, Volume 5 (1910), page 257.

† Piesse, C. H., Art of perfumery, (1891).

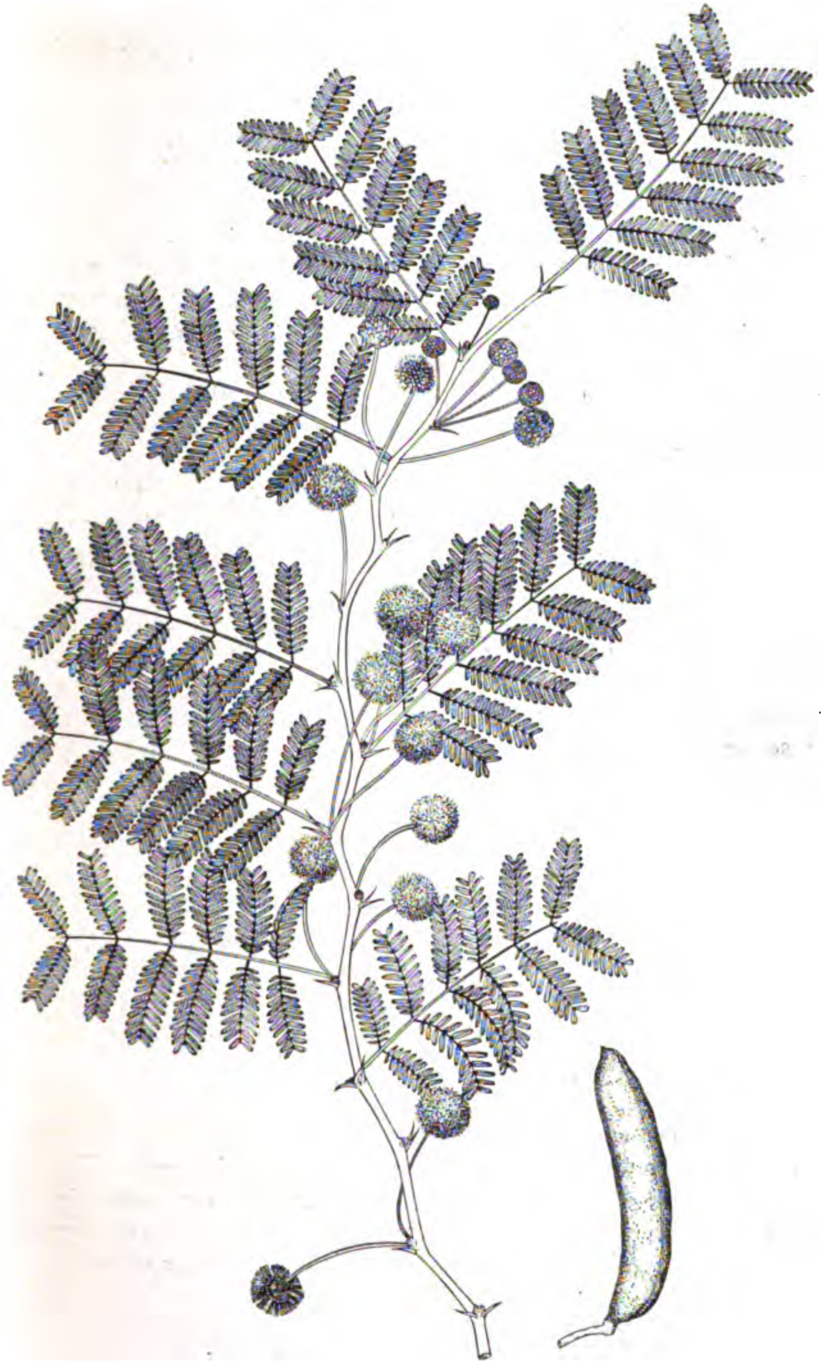

FIGURE 66. ACACIA FARNESIANA (AROMA), THE SOURCE OF CASSIE FLOWERS. X½.

used in preparing the best handkerchief bouquets and hair pomades. When diluted with other odors it imparts to the whole a true flowery fragrance.

The essential oil obtained from the flowers of *Acacia farnesia* is greenish yellow and viscid. This oil itself is never sold commercially, but is mixed with other substances and sold as perfumes, fixed oils, pomades, or extract of cassie.

Cassie perfume is prepared as a pomade by macerating the flower heads and placing the crushed material in purified melted fat where it is allowed to remain several hours. As many flowers are used as the fluid grease will cover. The spent flowers are next removed and replaced by fresh ones. This operation is continued until the grease has acquired a sufficient richness of perfume. Eight or ten treatments are usually necessary. The melted fat is then strained and cooled. This preparation, which is simply a solution of the true essential oil of cassie flowers in a neutral fat, is the commercial cassie pomade. More modern methods of preparing pomades such as that of cassie are described by Askinson.*

Extract of cassie is prepared by treating six pounds of cassie pomade, which is cut into small pieces, with one gallon of alcohol. Askinson * uses four pounds of cassie pomade to one gallon of alcohol. The alcoholic solution of the pomade is placed in securely stoppered bottles and allowed to remain three or four weeks at summer heat. The perfume which the fat contains is dissolved out by the alcohol. The mixture is then filtered. The residue of fat still contains some perfume and serves as an excellent material for the manufacture of hair dressing. The extract of cassie prepared in this manner has a fine olive-green color and the rich flowery odor of the cassie blossoms. It should be preserved in tightly stoppered bottles in a cool, dark place. This is necessary, as under the influence of light, heat, and air, the delightful odors of perfumes are gradually destroyed.

Cassie perfume may also be prepared by distilling the flowers and dissolving the essential oil thus obtained in alcohol. This method of preparation gives, however, an inferior product, which does not have the true, natural scent of the flowers. Usually, when the active odorous principle of the flower exists in unusually minute quantities as in such flowers as cassie, violet, and jasmine, a better grade of perfume is obtained by making a pomade, rather than by distilling.

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* Askinson, G. W., Perfumes and cosmetics, (1915).

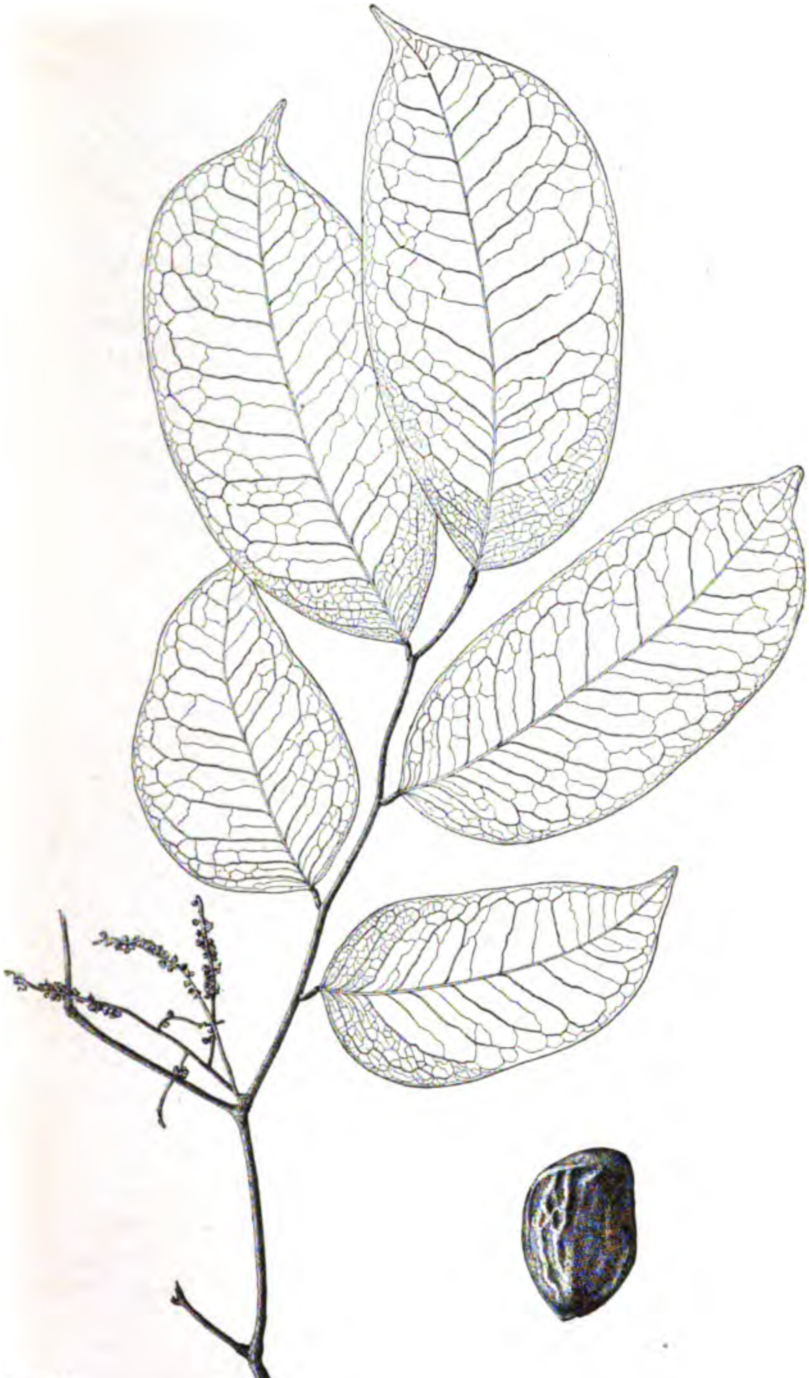

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FIGURE 67. KINGIODENDRON ALTERNIFOLIUM (BATÉTE), THE SOURCE OF BATÉTE INCENSE.

Acacia farnesiana is a large, spiny shrub or small tree from 3 to 4 meters in height. The leaves are 5 to 8 centimeters long, and bipinnate, usually with ten to twelve leaflets. The leaflets are 4 to 7 millimeters in length. The flowers are yellow and fragrant and are borne in dense, globose heads, which are about 1 centimeter in diameter. The pods are 5 to 7 centimeters long and 1 to 1.5 centimeters wide, straight or curved.

This species is probably a native of tropical America, but is widely distributed in waste places in the Philippines and is one of the commonest plants in the early stages of the invasion of grasslands by second-growth forests.

Genus KINGIODENDRON

KINGIODENDRON ALTERNIFOLIUM Merr. (Figs. 67, 68). BATÉTE.

Local names: *Batéte* (Tayabas, Sorsogon, Ticao Island, Masbate); *danggái* (Camarines, Tayabas, Albay, Sorsogon, Masbate); *duká* (Negros, Tablas Island, Leyte); *kalikít* (Agusan); *kumagasáka*, *paliná* (Agusan, Davao); *longbayau* or *manogbayo* (Agusan); *bagbalógo*. *magabalogo* (Samar); *palomaría* (Zamboanga); *salaláñgin* (Albay, Sorsogon); *sarok* (Davao); *painá*, *pariná* or *payiná* (Camarines, Albay, Sorsogon); *tuá-an* (Misamis).

BATÉTE INCENSE

Batete has a dark-green sap which thickens to a gummy consistency on exposure. Nothing is known of its chemical properties, but mention is made in Spanish literature of its use for incense.

Kingiodendron alternifolium is a tree reaching a height of 30 to 35 meters and a diameter of 80 to 100 centimeters. The bark is 7 to 10 millimeters thick, gray to gray brown with a yellowish tinge, and is shed in large scroll-shaped patches. The inner bark is red. The leaves are alternate, and simply compound with from 3 to 7, usually alternate, leaflets, which are smooth, leathery, pointed at the apex, rounded or pointed at the base, and from 8 to 18 centimeters long. The flowers are small and borne on compound inflorescences. The fruits are rounded or oval, frequently somewhat flattened, 4 to 5 centimeters long, and 3 to 4 centimeters wide.

This species is distributed from central Luzon to Mindanao.

Family RUTACEAE

Genus CITRUS

CITRUS HYSTRIX DC. (Fig. 69). KABÚYAU.

Local names: *Duñguruñgut* (Cagayan); *kabúyau* (Pampanga, Tarlac, Bulacan, Zambales, Bataan, Manila, Batangas, Laguna, Zamboanga);

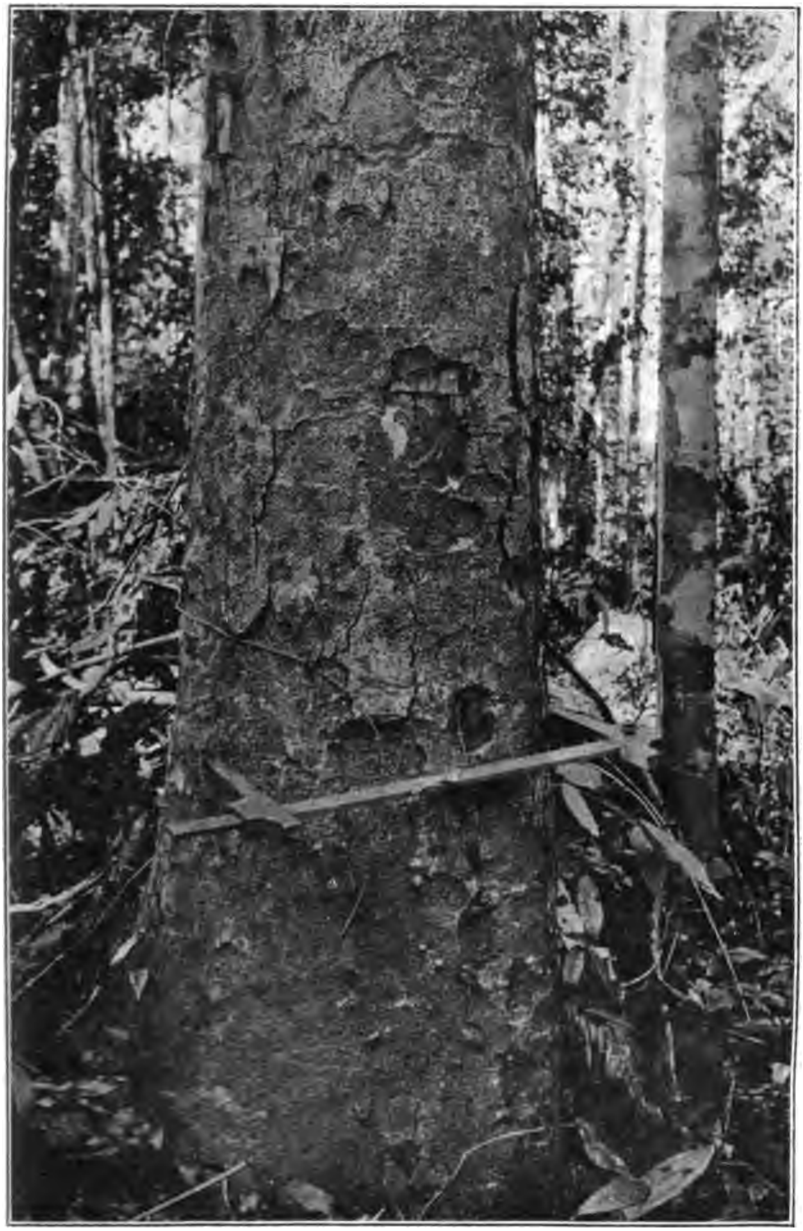

FIGURE 68. TRUNK OF KINGIODENDRON ALTERNIFOLIUM (BATÉTE), THE SOURCE OF BATÉTE INCENSE.

kabúgau (Camarines, Mindoro); *kamúlau* (Iloko); *kamuntai* (Bisaya); *kamúyau* (Ilocos Norte and Sur, Abra); *kapítan* (Iloko); *kolobót* (Tagalog); *limón-karabáu* (Zamboanga); *makatbá* (Zambales); *peres* (Pangasinan).

KABÚYAU OIL

Schimmel * states that the oil of this species has an odor resembling that of bergamot. According to Brooks,† the leaves of the Philippine plant when steam-distilled yield an oil resembling in odor the oil distilled from the leaves of the pomelo, *Citrus decumana* Murr. Although the oil is very fragrant, the yield (0.08 per cent) is extremely small. The constants of the oil are as follows: Specific gravity, $\frac{30^\circ}{30^\circ}=0.9150$; N $\frac{30^\circ}{D}=1.4650$; A $\frac{30^\circ}{D} = -10.50^\circ$; saponification number, 50.2.

Citrus hystrix is a small tree armed with small spines. The leaves are variable, but average 10 to 12 centimeters in length. The flowers are white and about a centimeter wide. The fruits are about 10 centimeters in diameter.

This species is common and widely distributed in forests throughout the Philippines.

CITRUS MICRANTHA var. MICROCARPA Wester. (Fig. 70). SAMÚYAU.

SAMÚYAU OIL

The rind of this species yields a clear, almost colorless oil which is very fragrant. It should be useful as a perfumery oil.

The crushed fruits or samúyau are used by women in Cebu for cleansing the hair, or are mixed with Gogo (pounded stems of *Entada phaseoloides*) which serves as a shampoo. The crushed fruit is also added to coconut oil, to give it fragrance when applied to the hair.

The oil obtained by steam-distilling the crushed peels had an orange-like odor and the following constants:

Specific gravity	28.5° =	0.8670
Refractive index	25° =	1.4718
Optical rotation (100 mm. tube)	A $\frac{30^\circ}{D}$ =	−1.150

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* Schimmel, Semi-annual report (1901).

† Brooks, B. T., New Philippine essential oils. Philippine Journal of Science, Section A, Volume 6 (1911), page 349.

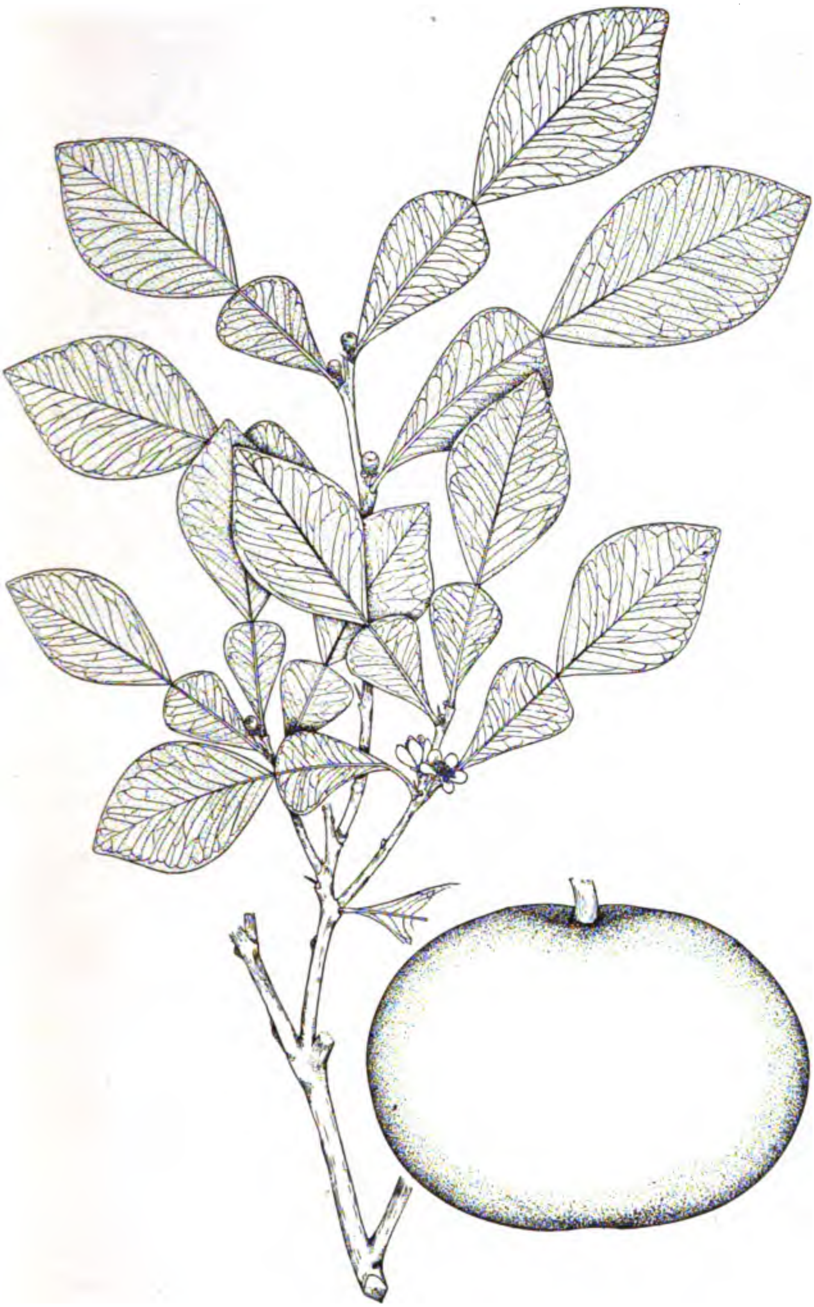

FIGURE 69. CITRUS HYSTRIX (KABÚYAU), THE SOURCE OF KABÚYAU OIL. ×½.

The yield of oil, calculated from the weight of the whole fruit, was 0.56 per cent and from the peel alone 1.29 per cent. The oil has been employed as an ingredient of shampoos.

The tree is said to bear fruits within five years after planting. The fruits are produced during the entire year, but most abundantly during the rainy season. In places where they are grown they sell for 5 centavos per hundred during the wet and 20 centavos per hundred during the dry season. Samuyau is said to be very delicate, and to need careful attention, and in Cebu, during the dry season, even daily watering.

Citrus micrantha var. *microcarpa* is a shrubby tree about 4.5 meters tall. It has slender branches and small, weak spines. The leaves are thin, with a distinct fragrance, 5.5 to 8 centimeters long, and 2 to 2.5 centimeters broad. The flowers are white with a trace of purple on the outside, and 5 to 9 millimeters in diameter. The fruit is 1.5 to 2 centimeters in diameter, roundish in outline, and greenish lemon-yellow.

This species is abundant in Cebu and other islands of the Bisaya group.

CITRUS Sp. GURONG̃-GURÓ.

Local names: *Bungkalót* (Laguna); *kabúrau* (Iloko); *kolison, muntai* (Tayabas); *gurong̃-guró* (Pangasinan, Zambales); *suang̃i* (Manila); *tibulíd* (Bulacan).

GURONG̃-GURO

This species has a very fragrant rind which is mixed with coconut oil for use on the hair. The whole fruit is also mixed with gogo (*Entada phaseoloides*) bark as a shampoo. Cloves are sometimes put into the rind and then the fruits squeezed in the hands to give them a pleasant odor. The fruit of this species is about 5 centimeters in diameter, with a very rough, irregularly ridged, green rind, and with a nipple-like protuberance at the base. The rind is rather thin, and the fruit is not edible.

Genus CLAUSENA

CLAUSENA ANISUM-OLENS (Blanco) Merr. (Fig. 71). KAYUMANÍS.

Local names: *Dayap-dayápan* (Laguna); *kayumanís* (Rizal).

CLAUSENA ANISUM-OLENS OIL

The leaves have an odor much like that of anise. Bacon * says that alcoholic extracts also have a very strong anise-like odor. According to him, it is possible that this plant could be used

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* Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), page 130.

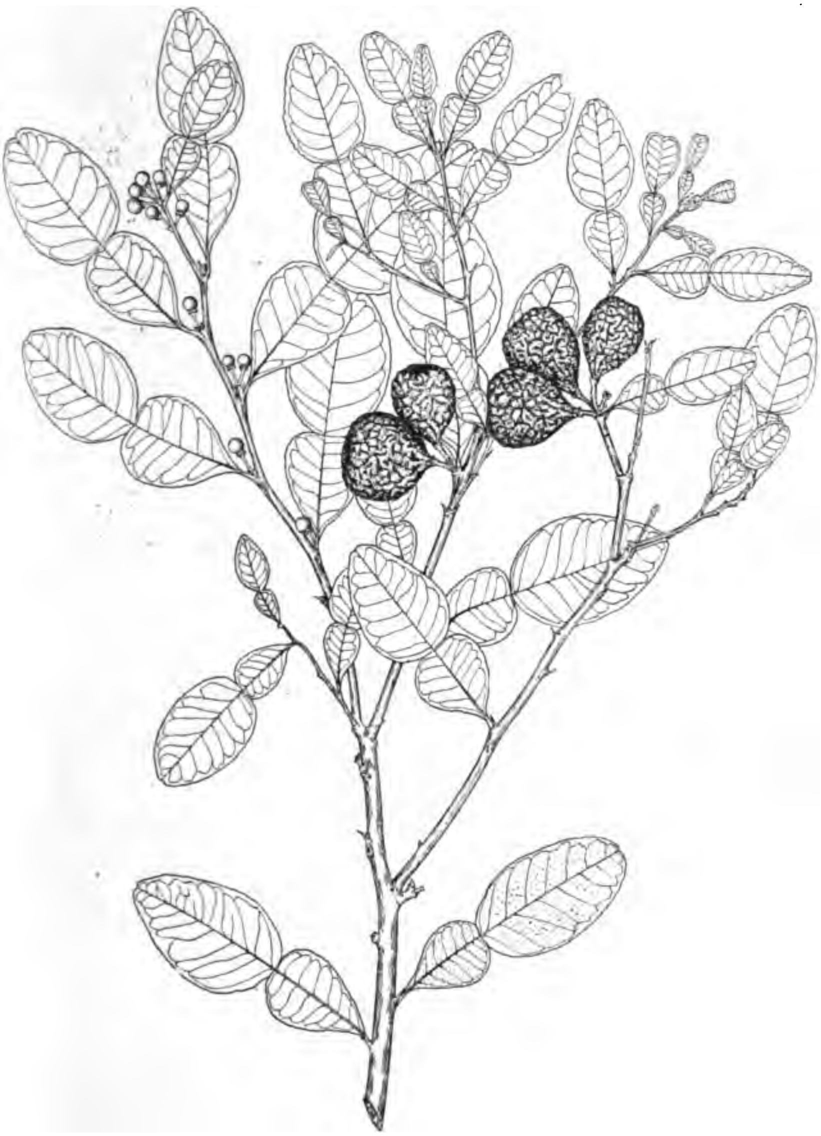

FIGURE 70. CITRUS MICRANTHA VAR. MICROCARPA (SAMOYAU), THE SOURCE OF SAMOYAU OIL. ×⅔.

locally in preparing anisado, which is a favorite alcoholic beverage among the Filipinos.

Brooks * examined the oil obtained from the leaves of this species and states that:

> A quantity of leaves, weighing approximately 16 kilos, were distilled with steam over a period of about five hours and 185 grams of colorless oil were obtained. This oil resembled the fresh leaves in odor and possessed the following constants. Specific gravity, $\frac{30^\circ}{30^\circ}=0.963$; N $\frac{30^\circ}{D}=1.5235$; saponification number 3.6; the oil is inactive. * * *
>
> The oil has a faint odor of anise or anethol, which, together with the constants, identifies it almost with certainty as methyl chavicol. For further proof, a small portion was oxidized with potassium permanganate to homoanisic acid, melting point, 84° to 86°. * * *
>
> Therefore, it is evident that the oil from *Clausena* contains methyl chavicol to the extent of 90 to 95 per cent. * * *
>
> The occurrence of methyl chavicol, especially in such large proportions, in one of the *Rutaceae* is quite novel. * * *
>
> Owing to the ease with which methyl chavicol is converted into anethol, by treatment with alkalies, it is possible that this operation would be successful commercially. Considerable quantities of anise oil are annually imported into the Philippine Islands for the manufacture of *anisado*. However it is doubtful whether or not *Clausena* could successfully be cultivated, as it is a typical forest species.

Clausena anisum-olens is a small tree, 3 to 6 meters high. The leaves are alternate, 20 to 30 centimeters long, compound, with 7 to 11 leaflets which are inequilateral, pointed at the tip, 5 to 11 centimeters in length, and with toothed margins. The leaves are aromatic when crushed. The flowers are greenish white, fragrant, about 8 millimeters in diameter, and are borne in panicles which are 15 to 20 centimeters long.

This species is a native of the Philippines, is widely distributed, and is abundant in some places. It is occasionally cultivated.

Genus TODDALIA

TODDALIA ASIATICA (L.) Kurz.

Local names: *Atáñgen, bugkáu, bukkáu, subit* (Benguet); *dauág* (Rizal).

TODDALIA ASIATICA OIL

According to D. Hooper,† the oil obtained by distilling the leaves of this species has a pleasant odor resembling verbena or basilicum. Gildemeister and Hoffman ‡ state that the oil

---

* Brooks, B. T., New Philippine essential oils. Philippine Journal of Science, Section A, Volume 6 (1911), page 344.

† Schimmel, Semi-annual report (1893).

‡ Die Aetherischen Öle, Berlin (1899), page 601.

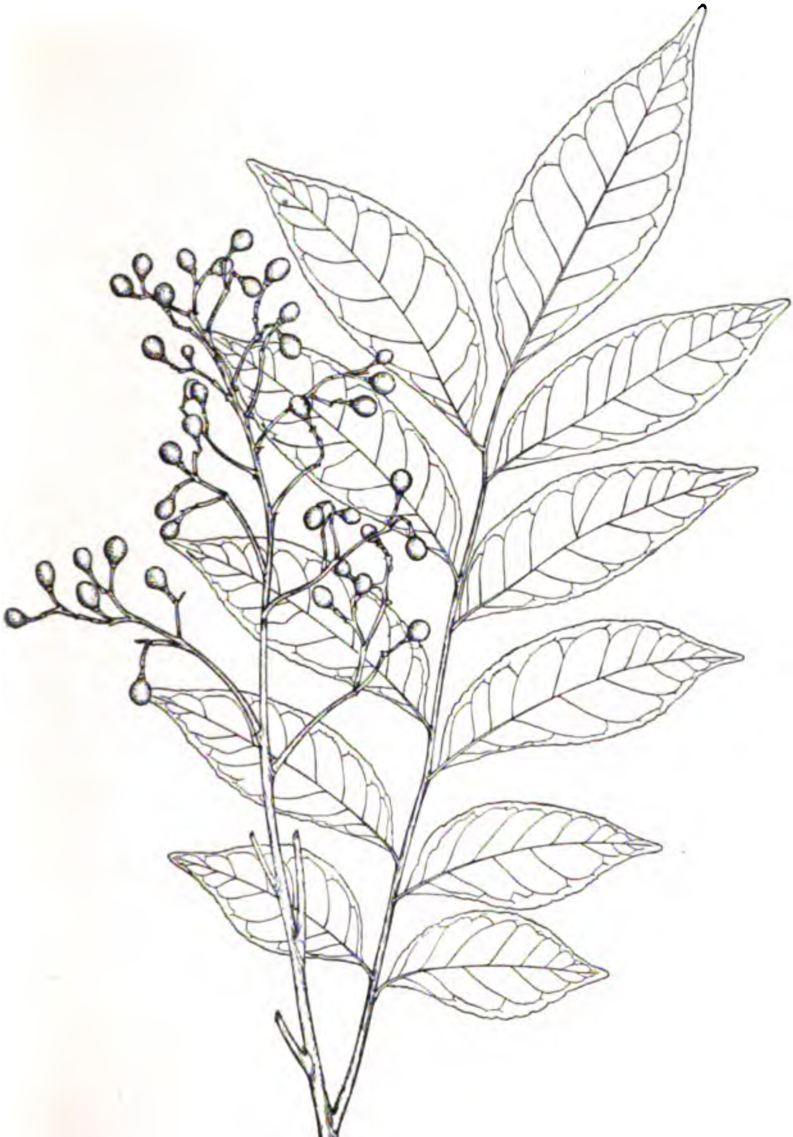

FIGURE 71. CLAUSENA ANISUM-OLENS (KAYUMANIS). ×½.

is valuable as a low-grade perfume oil. Brooks * says that it is commercially profitable to distill the oil. He reports his investigation as follows:

> The leaves yielded 0.08 per cent of oil by steam distillation. On freezing, the oil deposited 18 per cent of a white crystalline, very volatile compound, having an odor closely resembling that of camphor. After recrystallizing the substance twice from petroleum ether, the melting point was 96.5° to 97°. The compound is very unstable. A pure specimen of it changed in 24 hours to a pasty mixture of oil and unchanged crystals. It was not further investigated. The oil had an odor suggesting a mixture of camphor and lemon grass. Its constants were as follows: $N\frac{30^\circ}{D}$, 1.4620; specific gravity, $\frac{30^\circ}{30^\circ}$ 0.9059.
>
> The oil is largely linaloöl, since the fraction boiling from 195° to 200° yields citral on oxidation with chromic acid mixture.

Toddalia asiatica is a spiny, woody vine. The leaves are alternate and trifoliate. The leaflets are pointed at both ends and 5 to 8 centimeters in length. The flowers are small, greenish, and borne on rather large compound inflorescences. The fruits are small and are borne in fairly large clusters. They are considerably less than a centimeter in diameter and when dry are distinctly three- to five-angled.

This species is common in second-growth forests and is also found in virgin forests.

Family VERBENACEAE

Genus LANTANA

LANTANA CAMARA L. LANTÁNA.

Local names: *Albahaca de caballo* (Spanish in Zamboanga); *bahug-bahug* (Negros); *boho-boho* (Iloilo); *coronítas* (Manila); *lantána* (Tarlac, Cavite, Batangas, Laguna); *tinta-tintáhan* (Manila).

LANTÁNA OIL

This species has very aromatic leaves from which Bacon † obtained an oil having an odor somewhat like that of sage. Concerning his experiments he writes:

> Seventy kilos of the leaves distilled with steam gave 60 cubic centimeters of a light yellow oil; 100 kilos gave 245 cubic centimeters, and 110 kilos gave 78 cubic centimeters of oil.
>
> These results show that the yield of oil evidently varies considerably, the differences depending upon the season, age of the leaves, etc. The oil has a specific gravity of $\frac{30^\circ}{4^\circ}=0.9132$; $N\frac{30^\circ}{D}=1.4913$; $A\frac{30^\circ}{D}=+11.5$. Its

---

* Brooks, B. T., New Philippine essential oils. Philippine Journal of Science, Section A, Volume 6 (1911), page 333.

† Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), page 127.

odor reminds me somewhat of sage. Fifty grams distilled *in vacuo* gave two fractions as follows:

(1) Twenty-two grams boiling between 125° to 130° at 12 millimeters $N_{D}^{30^\circ}=1.4892$.

(2) Twenty-four grams boiling between 130° and 140° at 11 millimeters; $N_{D}^{30^\circ}=1.4970$.

If on further investigation this oil proves to be of any value, the cultivation of the plant is certainly a commercial possibility.

Lantana camara is an erect or half-climbing, hairy, aromatic shrub, usually 1 to 2 meters in height when erect, and higher when climbing. The leaves are rounded at the base and pointed at the tip, with toothed margins, and are from 5 to 10 centimeters in length. The flowers are pink, red, or yellow, and are borne in many-flowered heads. The fruit is a small, almost black berry.

This species grows abundantly and luxuriantly and is common in the waste places of the Philippines. It is a native of tropical America.

Family LABIATAE

Genus OCIMUM

OCIMUM BASILICUM L. BALANÓI or SWEET BASIL.

Local names: *Albaháca* (Spanish); *balanái* (Rizal); *balanói* (Batanes Islands, Tayabas); *bauing, solási* (Balabac Island); *bidái* (Union); *kalu-ui* (Basilan); *kamáñgi* (Culion Island).

SWEET BASIL OIL

Watt [*] says that:

> "The whole plant has an aromatic odor, which is improved by drying. Its taste is aromatic and somewhat cooling and saline." (*Pharmacog. Ind.*) The seeds, which are much used medicinally in some parts of India, are small, black, oblong (one-sixteenth inch long), slightly arched on one side and flattened on the other, blunt pointed. They have no odor, but an oily, slightly pungent taste. When placed in water they become coated with a semi-transparent mucilage. Steeped in water, they form a mucilaginous jelly (*U. C. Dutt, Murray, Dymock, &c.*). Their properties are said to be demulcent, stimulant, diuretic, and diaphoretic. * * *
>
> The plant has a strong aromatic flavor like that of cloves and is often used for culinary purposes as a seasoning. The seeds are sometimes steeped in water and eaten. They are said to be cooling and very nourishing. In Kanawar they are sometimes eaten mixed in ordinary bread (*Stewart, Pb. Pl.*). They are largely employed, especially by the Mohammedans of Eastern Bengal, infused in water, to form a refreshing and cooling drink.

When the herb *Ocimum basilicum* is distilled it yields sweet basil oil, which is a yellowish-green, volatile oil lighter than water. Parry[*] states that it has an excellent fragrance and is used in making mignonette extract. The yield of oil obtained from the herb is about 1.5 per cent or less.

---

[*] Watt, G., Dictionary of the economic products of India. Volume 5 (1891), page 441.

Ocimum basilicum is an erect, branched under-shrub 0.5 to 1.5 meters in height. It is smooth, or somewhat hairy, and very aromatic. The leaves are entire or slightly toothed and 1.5 to 3 centimeters long. The flowers are borne in racemes which are 8 to 15 centimeters long. The corolla is pink or purplish and 9 to 10 millimeters long.

This species is apparently common and widely distributed from the Batanes Islands to southern Mindanao.

Genus OCIMUM

OCIMUM SANCTUM L. SULÁSI or HOLY BASIL.

Local names: *Albahâca*[†] (Spanish); *balanói* (Tagalog); *bidái* (Iloko); *kolokogo* (Tayabas); *kalúi* (Basilan); *kamáñgi* (Bisaya); *katigau* (Misamis); *kamangkáu* (Camarines); *lokolokó* (Polillo); *magau* (Cotabato); *sulási* (Tagalog).

HOLY BASIL OIL

This species, known as holy basil or tulsí, is the sacred plant of India.

Watt[‡] states that:

> The *Tulsí* is the most sacred plant in the Hindu religion; it is consequently found in or near almost every Hindu house throughout India. Hindu poets say that it protects from misfortune and sanctifies and guides to heaven all who cultivate it. * * * Under favourable circumstances, it grows to a considerable size, and furnishes a woody stem large enough to make beads for the rosaries used by Hindus on which they count the number of recitations of their deity's name.

According to Bacon[§] 13.86 kilos of leaves which were forty-eight hours old at the time of distillation gave 83.3 grams of a green-colored oil (0.6 per cent). This oil had a sweet, anise-like odor and the following properties:—Refractive index, $N\frac{30^{\circ}}{D}=1.5070$; optical rotation, $A\frac{30^{\circ}}{D}=0$; specific gravity, $\frac{30^{\circ}}{30^{\circ}}=0.952$; saponification number, 2.8.

---

[*] Parry, E. J., Chemistry of essential oils and artificial perfumes, page 308.

[†] This name belongs properly to the preceding species.

[‡] Watt, G., Dictionary of the economic products of India, Volume 5 (1891), page 444.

[§] Bacon, R. F., Philippine terpenes and essential oils, IV. Philippine Journal of Science, Section A, Volume 5 (1910), page 261.

The oil consists to a large extent of methyl homoanisic acid, melting at 85°, being obtained by oxidizing the fraction boiling from 85° to 95° at 9 millimeters pressure. Bacon also states that 65 small plants gave 2.5 kilos of fresh leaves, which when steamed-distilled gave 32 grams of oil.

Ocimum sanctum is an erect, herbaceous or half-woody, coarse plant, 1 meter or less in height. The stems and younger parts of the plant are covered with spreading hairs. The leaves are opposite, pointed at the tip, somewhat rounded or pointed at the base, 2 to 4 centimeters long, and with toothed margins. The flowers are about 7 millimeters long and pink.

This species is cultivated for its fragrant leaves and is occasionally spontaneous in waste places. It is found throughout the Philippines, but is certainly not a native of the Archipelago.

Genus POGOSTEMON

POGOSTEMON CABLIN Benth. (Fig. 72). PATCHOULI or KABLÍN.

Local names: *Kabiling* (Pampanga); *kablín* (Ilocos Sur, Abra, Bontók, Tagalog provinces); *kabling* (Ilocos Sur, Bulacan, Laguna, Mindoro); *kadlín* (Batangas); *kadling* (Rizal); *kadlóm* or *kadlúm* (Tagalog provinces, Camarines, Albay, Sorsogon, Leyte); *sárok* (Igorot).

PATCHOULI OIL

The species *Pogostemon cablin* is highly valued for the perfume oil, patchouli, obtained from its leaves. The dried leaves, which are very fragrant, are sometimes used for scenting wardrobes. It is said that they prevent the clothes from being attacked by moths. Patchouli is a common perfume in India and China, and goods, such as shawls, exported from these countries owe their peculiar odor to the patchouli plant.

The dried leaves of *Pogostemon cablin,* when distilled, yield about 3.5 per cent of patchouli oil, which is used in making perfumes and scented soaps. Formerly patchouli oil was considered a very high-grade perfume base, but it is now more frequently used in lower grades. The pure oil has a strong musky odor and is mixed with other essential oils in making perfumes.

According to Mann,* the etheral oil is present in small quantities in the fresh leaves, and only develops through a kind of fermentation of the cut leaves packed into bundles. This explains why the yield from the dried leaves is about 3.5 to 4 per cent, while from fresh leaves it is much less. Mann says that the pronounced patchouli scent is only popular in a very few cases, like the export business to tropical countries. However, the oil serves many purposes in perfumery, giving a fine shade to various combinations without being obtrusive. It is therefore valuable as a so-called fixing agent. It is used with otto of roses, jasmine, cassia, fine musk and labdanum. For cheaper qualities of patchouli perfumes, benzylacetate is a very good material; it aids in dissipating the severe patchouli odor and for this reason is frequently utilized. With very cheap articles, oil of cloves and also artificial musk are employed. The scent is used with good results to combat the frequently very obtrusive odor of perspiration, completely suppressing it. Mann says:

---

* Mann, H., The American Perfumer, Volume 8 (1913–1914), page 144.

> Besides patchouli perfumes, patchouli toilet water also is used. This is especially popular with the harem ladies of Turkish and Arabic Pashas, who pay enormous prices for fine qualities. These toilet waters are worked with infusion of jasmine, but there are also some to be found in trade containing menthol, which gives an odd shade, and is very well liked. Otto of roses also is added and so is some fine kananga oil, all in combination with the finest patchouli oil, thus preventing its domination.

Askinson * gives the following formulas for patchouli perfumes:

Essence of patchouli

Oil of patchouly	ounces	1½
Oil of rose	do	⅜
Alcohol	quarts	5

Extract of patchouli

Extract of orange flower	quart	1
Oil of patchouly	ounces	1½
Oil of rose	grains	150
Alcohol	gallon	1

Patchouli powder

Patchouly herb	pounds	2
Oil of patchouly	grains	30
Musk	do	15

The constants of patchouli oil obtained from different countries vary considerably. This is shown by the figures in Table 35 which are quoted by Parry.†

TABLE 35.—*Constants of patchouli oil.*

Constants.	Java plants.	Singapore plants.
Specific gravity	0.922 at 25°	0.949 at 25°
Optical rotation	−16° 10′	−58° 24′
Initial boiling point	180°	230°
Distils between 250°—270°	50 per cent.	60 per cent.

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* Askinson, G. W., Perfumes and cosmetics, (1915).

† Parry, E. J., The chemistry of essential oils and artificial perfumes, (1908).

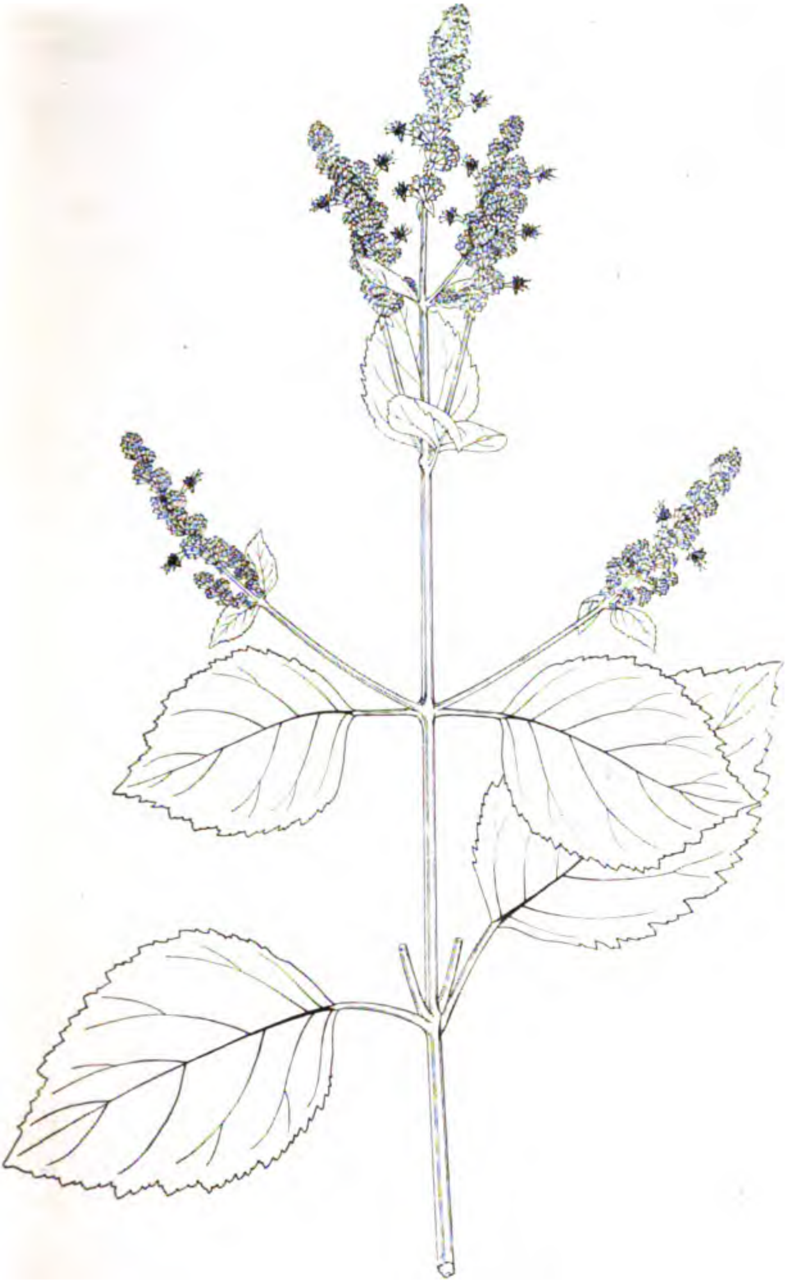

FIGURE 72. POGOSTEMON CABLIN (PATCHOULI OR KABLIN), THE SOURCE OF PATCHOULI OIL. ×⅓.

According to Gildermeister–Kremers * patchouli alcohol, $C_{15}H_{26}O$, is an odorless constituent of patchouli oil, from which it separates in crystals that melt at 56°.

Pogostemon cablin is an erect, branched, hairy herb .5 to 1 meter in height. It is aromatic when crushed. The leaves are opposite, pointed at the tip, and usually obtusely pointed at the broad base. The margins are coarsely and doubly toothed. The flowers are borne in terminal and axillary spikes which are 2 to 8 centimeters long and 1 to 2.5 centimeters in diameter. The corolla is pink-purple and 8 millimeters long.

This species is found throughout the Philippines in cultivation and is also wild. There seems to be a great deal of uncertainty as to the original home of *Pogostemon cablin.* It is cultivated in many parts of the Indo-Malayan region, but apparently rarely, if ever, flowers in India, Ceylon, Singapore, and Java. It appears to produce flowers freely only in the Philippines.

Family COMPOSITAE

Genus BLUMEA

BLUMEA BALSAMIFERA DC. (Fig. 73). SAMBÓNG.

Local names: *Alibhón* (Negros); *alimón* (Negros); *bukadkád* (Samar); *kalibón* (Cuyo Islands); *kalibura* (Palawan); *lakadbúlan* (Camarines); *sambón* (Zamboanga); *sambóng* (Tarlac, Bataan, Bulacan, Manila, Palawan, Laguna, Mindoro, Basilan, Tayabas, Zambales, Batangas, Rizal, Balabac Island, Misamis); *sobósob* (Ilocos Norte and Sur, Abra, Pangasinan); *takamain* (Davao).

SAMBÓNG OIL

The leaves of *Blumea balsamifera* are used locally for poisoning fishes, and medicinally for a number of purposes. The roots are also utilized medicinally.

Bacon † distilled the leaves of this plant and obtained a yield of from 0.1 to 0.4 per cent of a yellow oil with a camphor-like odor. This oil was almost pure l-borneol. As this substance readily oxidizes to camphor, the oil, according to Bacon, should be valued at from one-half to three-fourths of the price of the camphor. Bacon estimates that the leaves could be cut four times a year. According to some experiments made in Indo-China, ‡ it is possible to obtain 50,000 kilos of leaves per hectare

---

* Gildermeister, E. and Kremers, E., The volatile oils, (1913).

† Bacon, R. F., Philippine terpenes and essential oils, III. Philippine Journal of Science, Section A, Volume 4 (1909), page 127.

‡ Lan, M. M., Camphus du Tonkin. Bulletin Economique, Gouvernement General de L'indo-Chine. New Series Volume 9 (1907), page 192.

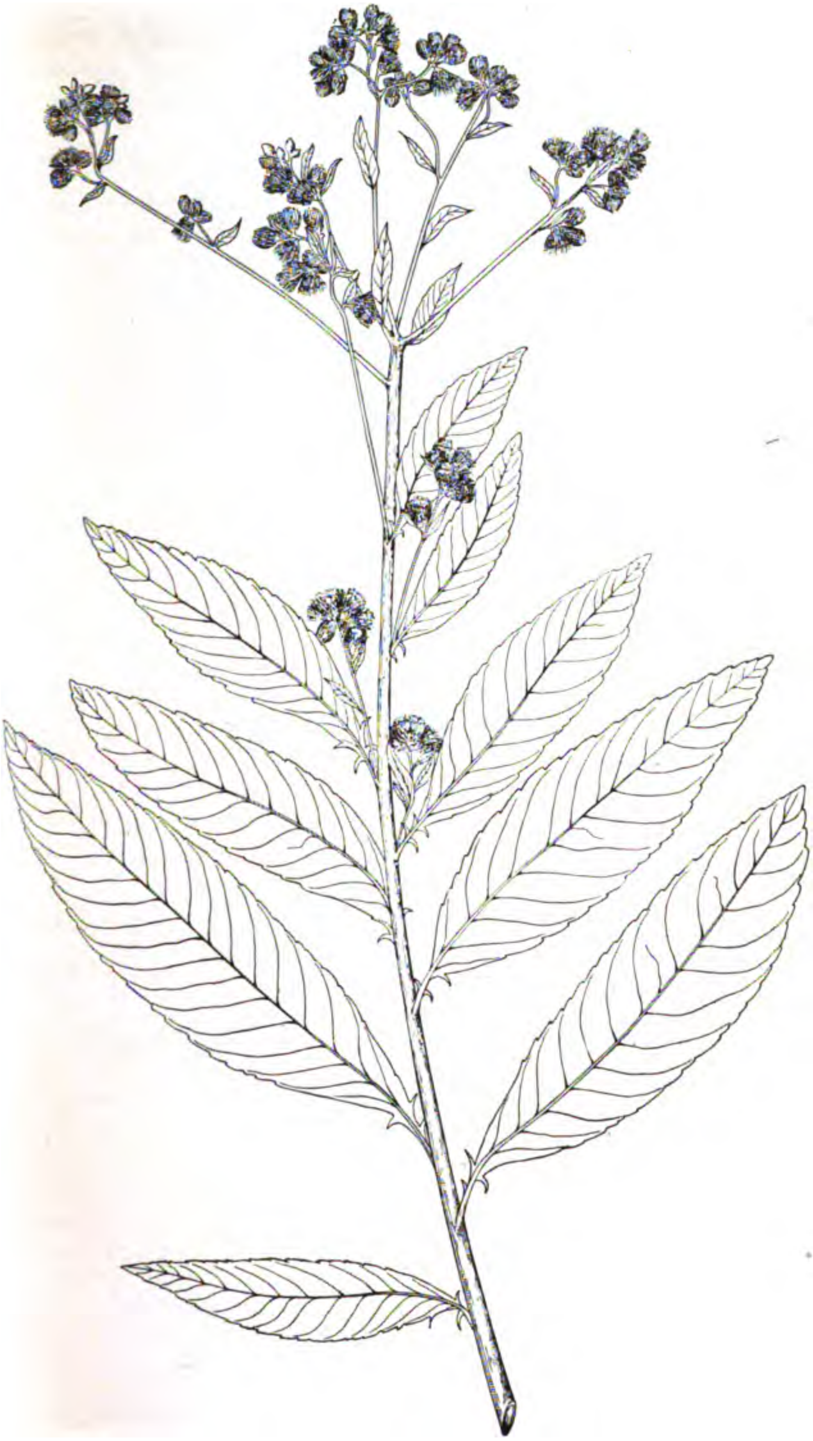

FIGURE 73. BLUMEA BALSAMIFERA (SAMBÓNG), A SOURCE OF CAMPHOR. ×½.

per year, which would give a possible borneol yield of from 50 to 200 kilos per hectare. Although this plant grows vigorously in the Philippines, it is questionable if it could be cultivated profitably.

Blumea balsamifera is a coarse, erect, half-woody herb 1.5 to 3 meters in height. The stems are 2.5 centimeters in diameter. The leaves are from 7 to 20 centimeters in length, spear shaped, and with toothed margins and short petioles.

This species grows very abundantly in waste places in the Philippines. It is frequently found in grass areas, as it readily sprouts from the ground after the aerial parts of the plant have been killed by fire. It is thus one of the comparatively few species of plants which can withstand grass fires.

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Wild Food Plants o
Philippines

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Department of Agriculture and Natural Resour
Bureau of Forestry

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With the Compliments of the Director of Forestry

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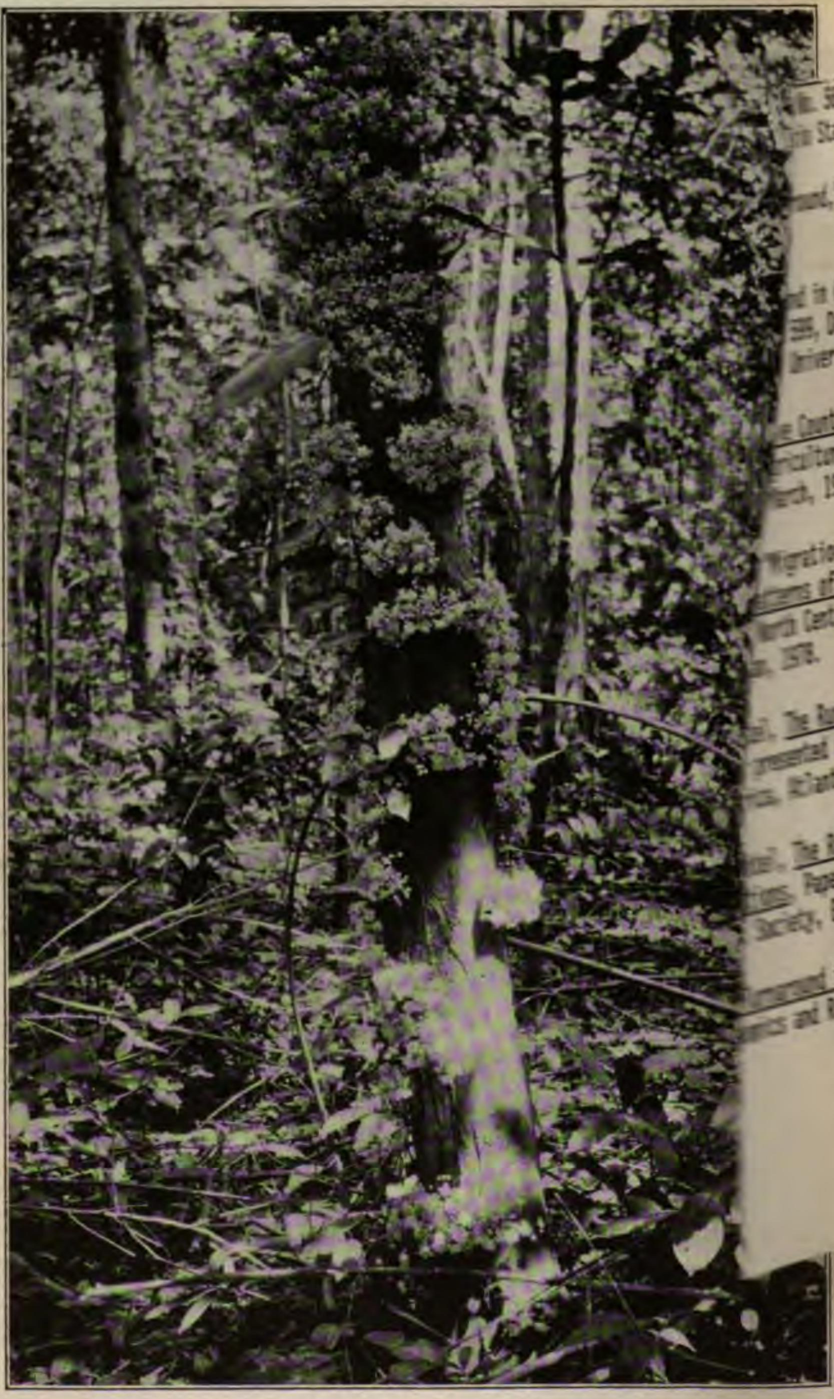

FIGURE 1. EUGENIA MANANQUIL (MANANGKIL) IN FLOWER.

Wild Food Plants of the Philippines

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PREFACE

This bulletin is the seventh in a series dealing with minor forest products. At the present time, when considerable effort is being made to increase the food supply of the Philippines, it is believed that an account of the wild food plants of the Archipelago should prove of value.

In discussing the various species of plants the following system has been used: On the left of the page is given the scientific name, and on the right the local name adopted as official by the Bureau of Forestry. This is followed by a list of local names in the various localities. The first part of the description gives an account of the edible portion of the plant. After this there is a paragraph which begins with the scientific name and gives a general description of the species. The last paragraph gives the distribution.

The writer is greatly indebted to Mr. E. D. Merrill for valuable assistance and suggestions and to Mr. E. E. Schneider for revising the spelling of the local names and for much valuable data. The original drawings were made under the direction of Mr. J. K. Santos by Messrs. F. de la Costa, P. C. Cagampan, F. Turla, A. Hernandez, and F. S. Guerrero.

WILLIAM H. BROWN.

WILD FOOD PLANTS OF THE PHILIPPINES

By WILLIAM H. BROWN

INTRODUCTION

There is a very commonly accepted belief in temperate countries that fine, edible fruits abound in tropical forests. This idea is largely erroneous. In the Philippines, with its varied flora, there are probably fewer fine, edible, wild plants than in the eastern part of the United States. Moreover, such wild plants as are edible are usually inaccessible, and less abundant than is the case in the United States.

Wild fruits or nuts occurring in the Philippines are generally of an inferior quality, or are borne in such small numbers, or so high up in the trees, as to make their collection difficult. There are, however, some striking exceptions. The pili nut (*Canarium luzonicum*), considered by most people as superior to the almond, is abundant and is a staple article of commerce in the Philippines. One of the wild mangoes (*Mangifera caesia*) has a fine flavor and is sold in the markets in the regions where it occurs. The duhat (*Eugenia cumini*), although not a native of the Philippines, is thoroughly naturalized at low elevations throughout the Archipelago and is very abundant. The fruit is good, and is sold in large quantities. Among other wild fruits which are commonly seen in the markets are mabolo (*Diospyros discolor*), guava (*Psidium guajava*), santol (*Sandoricum koetjape*), kamachile (*Pithecolobium dulce*) and bignai (*Antidesma bunius*). These, though favorites with the Filipinos, do not seem to appeal to American tastes. A number of others have fine flavors but, in general, are not articles of commerce.

The leaves and young fruits of a number of wild species are cooked and eaten as vegetables. Some of these have very good flavors.

In many cases, the plants might be improved by cultivation, or could serve as stock on which to graft other species, or be used for breeding purposes.

In making a list of edible plants, the species included will depend to a considerable extent on personal judgment. Many people may consider some of those treated in the present list as worthless, and some common species which are omitted as good. A list which included all the species that could be eaten would be very much longer than the present one. Many of the fruits are so small, so lacking in flavor, or of such poor flavor, that they are practically never eaten, even by people in the woods. It has not been considered worth while to include such species. The number of species which are considered as edible will depend to a considerable extent on the density of the population and the amount of food available. Where the population is dense and food is scarce, many inferior food plants are eaten. The lists of edible plants from neighboring and more densely populated countries include many which in the Philippines are not considered as edible.

The present list of wild Philippine food plants, although probably very far from complete, is much more nearly so than any previous one. It is believed that it contains the better-known species, and it is hoped that it may serve as a beginning on which to build up a better list.

DESCRIPTIONS OF SPECIES

Family POLYPODIACEAE

Genus ATHYRIUM

ATHYRIUM ESCULENTUM Copel. (Figs. 2, 3). PAKÓ.

The young fronds of this fern are eaten in all parts of the Islands, either fresh as a salad or cooked as a green vegetable. In many Philippine towns pakó can always be found in the market.

Athyrium esculentum has twice or thrice pinnate fronds, which are 50 to 80 centimeters long, and about half as wide as long.

This species is widely distributed in the Archipelago and is a characteristic plant on gravel bars and banks of swift streams.

Family OPHIOGLOSSACEAE

Genus HELMINTHOSTACHYS

HELMINTHOSTACHYS ZEYLANICA (L.) Hook. TÚKOD.

Local names: *Tumatanud* (Samar); *kaliti* (Bataan); *túkod* (Pangasinan); *túkod-banuwá* (Rizal); *túngkut-láñgit* (Pampanga).

The young fronds of this fern are eaten raw as a salad or cooked as a vegetable.

Helminthostachys zeylanica is an herb with leaves which grow singly from an underground rhizome. The leafstalk is up to 30 centimeters in length and bears at the apex a three-parted, sterile frond. The fertile part is spike-like and arises from the stalk.

This species is locally abundant in thickets at low altitudes. It is rather extensively used for food.

Family CYCADACEAE

Genus CYCAS

CYCAS CIRCINALIS L. (Figs. 4, 5). PITÓGO.

Local names: *Baít* (Tawi-Tawi); *bayít* (Basilan); *olíva* (Zambales, Bataan, Laguna, Tayabas, Cavite, Camarines, Mindoro); *olívo* (Cagayan); *patúgo* (Batangas); *pitógo* (Tayabas, Negros Occidental); *sauang* (Cagayan).

In times of famine, the ripe seeds of this plant are prepared as food in some of the isolated parts of the Philippines,

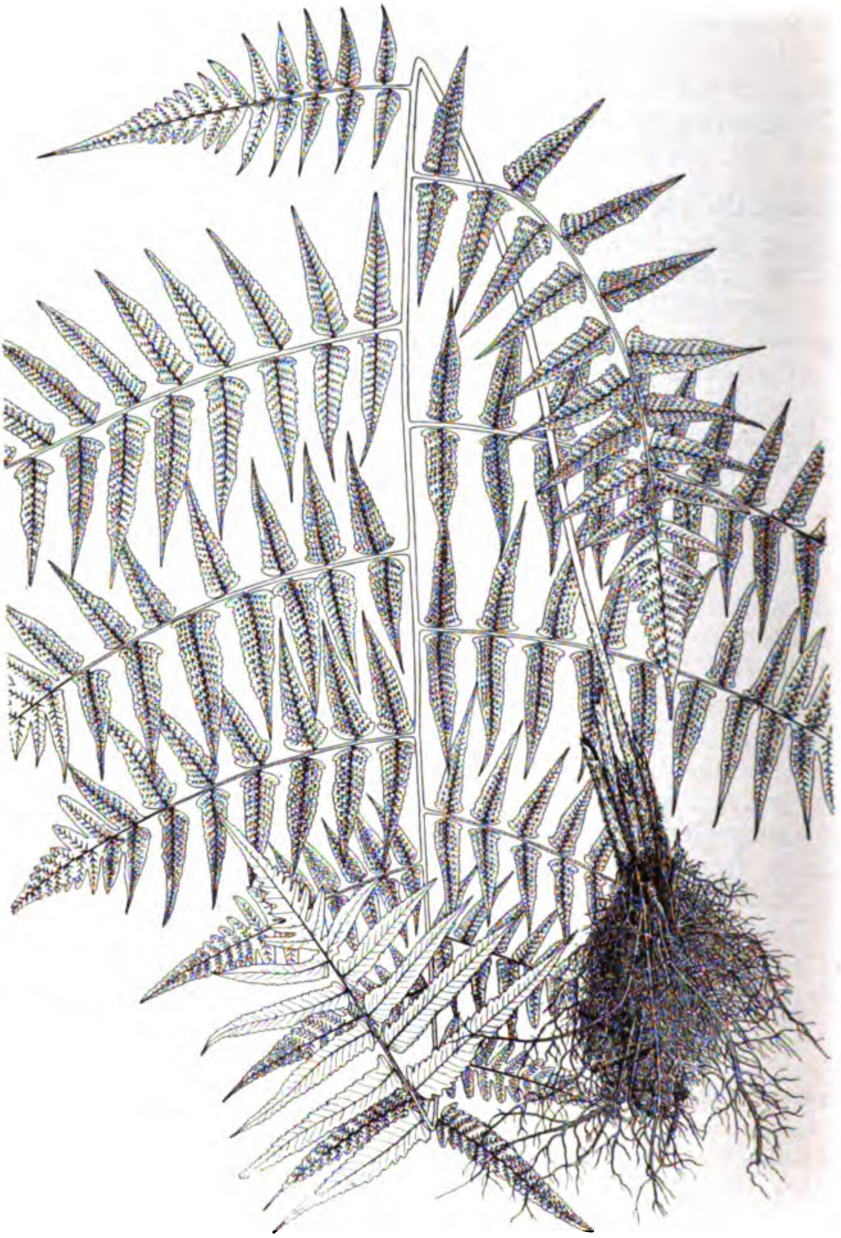

FIGURE 2. ATHYRIUM ESCULENTUM (PAKO). ×[illegible].

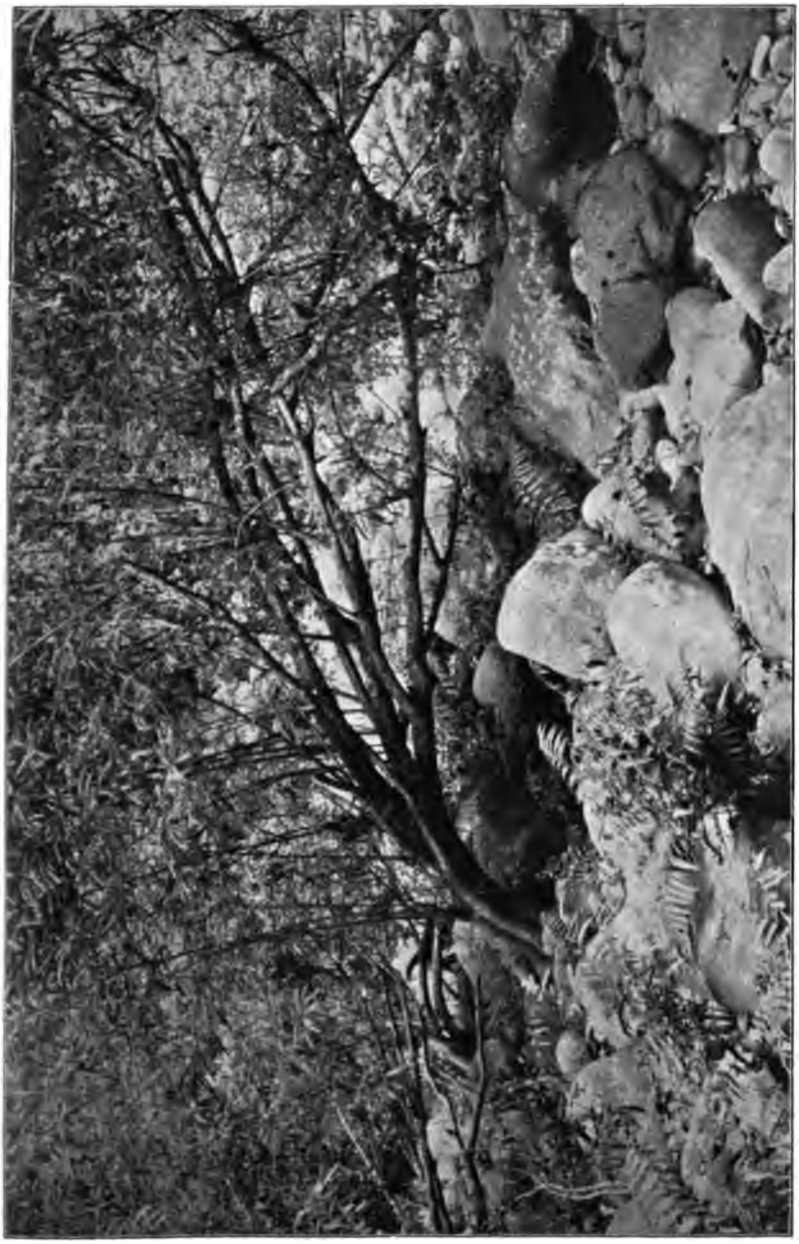

FIGURE 3. HABIT OF ATHYRIUM ESCULENTUM (PAKO).

such as the Batanes Islands. In Guam, according to Safford,[*] *Cycas* seeds are a staple article of food in times when better foods are scarce. As the untreated seeds are poisonous, it is first necessary to eliminate the poisonous principle. In order to do this, the ripe seeds are crushed and the resulting product soaked in water which must be changed several times. The product is then dried, and the flour-like substance cooked in the form of small cakes or as porridge. Bacon [†] found the starch content of mature seeds to be 31.2 per cent. In India a kind of sago [‡] is prepared from the starch stored up in the trunk, but there in no evidence to show that this product is known in the Philippines. However, the yield of starch is small, as a trunk 4 feet in length produced only five pounds.

In some parts of the Philippines, the young leaves, when about 30 or 40 centimeters long and still rolled up, are cooked and eaten as a vegetable.

The leaves are also used extensively in religious ceremonies.

Cycas circinalis has a stout stem which reaches a height of 12 meters and a diameter of 50 centimeters, although it is usually much smaller than this. The leaves are produced in a cluster at the top of the trunk, are pinnate, and from 0.5 to 1.5 meters long.

This species is widely distributed in the Philippines, but is nowhere abundant except in small areas. It is of local occurrence and is generally found near the seashore. It is decidedly ornamental, and in Manila is planted to a considerable extent for decorative purposes.

Family GNETACEAE

Genus GNETUM

GNETUM GNEMON L. BÁGO.

A description of this species and its local names are given in the bulletin on fibers.

The fruit is eaten either boiled or roasted, while the young leaves are frequently used as a vegetable. This species is commonly cultivated in some of the towns of Batangas Province, Luzon, for its edible leaves and fruit.

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[*] Safford, W. E., The useful plants of the Island of Guam. Contributions from the United States National Herbarium. Volume IX (1905).

[†] Bacon, R. F., Starch production in the Philippine Islands. Philippine Journal of Science, Volume 3 (1908), page 96.

[‡] Cycad sago. Tropical Agriculturist, Volume 26 (1906), page 386.

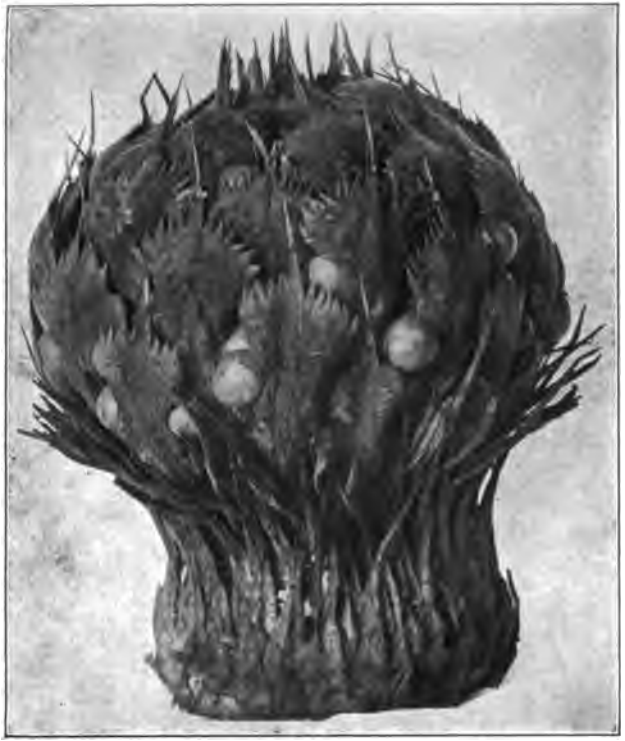

FIGURE 4. FEMALE CONE OF CYCAS CIRCINALIS (PITOGO).

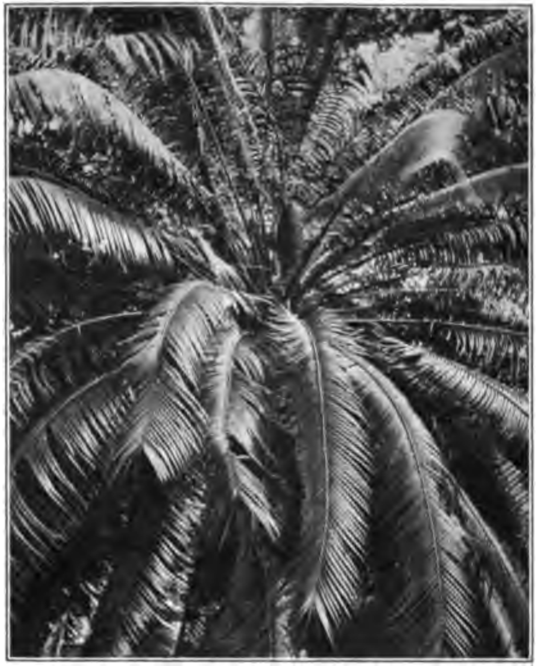

FIGURE 5. CYCAS CIRCINALIS (PITOGO) WITH MALE CONE.

The bark yields a stout bast fiber.

The fruit of *Gnetum gnemon* is red, ovoid or ellipsoid, pointed, variable in size, but usually not exceeding 2.5 centimeters in length.

According to Heyne,* the young leaves, flowers, and fruits are favorites for stews. He says that in Java the ripe fruits are roasted and pounded while hot into thin, round cakes which are cooked in boiling oil, when they puff up into a porous, crisp cake called *krupuk*.

GNETUM INDICUM (Lour.) Merr. (Fig. 6).

A description of this species and its local names are given in the bulletin on fibers.

The kernels of the fruit are eaten either boiled or roasted. When freshly cut the stems yield a good quality of drinking water; and the plant is commonly utilized for this purpose by people in the forest, when other drinking water is not available.

The bast is very tough and is used in making cordage.

Family ALISMACEAE

Genus SAGITTARIA

SAGITTARIA SAGITTIFOLIA L.

Local names: *Gauai-gáuai* (Samar); *tikog* (Camarines).

This plant produces edible tubers.

Sagittaria sagittifolia is a coarse herb with arrow-shaped leaves. The flowers are white with a yellow center.

This species is distributed in swamps and muddy places from Luzon to Mindanao.

Family HYDROCHARITACEAE

Genus ENHALUS

ENHALUS ACOROIDES Steud. LAMÓN.

Local names: *Lamón* (Tagalog, Bikol); *mariu-báriu* (Bikol); *pallaipat-baibai* (Union).

In some parts of the Malayan region the seeds of this plant are eaten either raw or cooked, but this use is not recorded from the Philippines. The fruits are about the size of a large walnut and contain eight or nine green seeds.

Enhalus acoroides has ribbon-like leaves which rise from the base of the plant. The flowers are borne singly on long, rather slender stalks.

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 1, page 20.

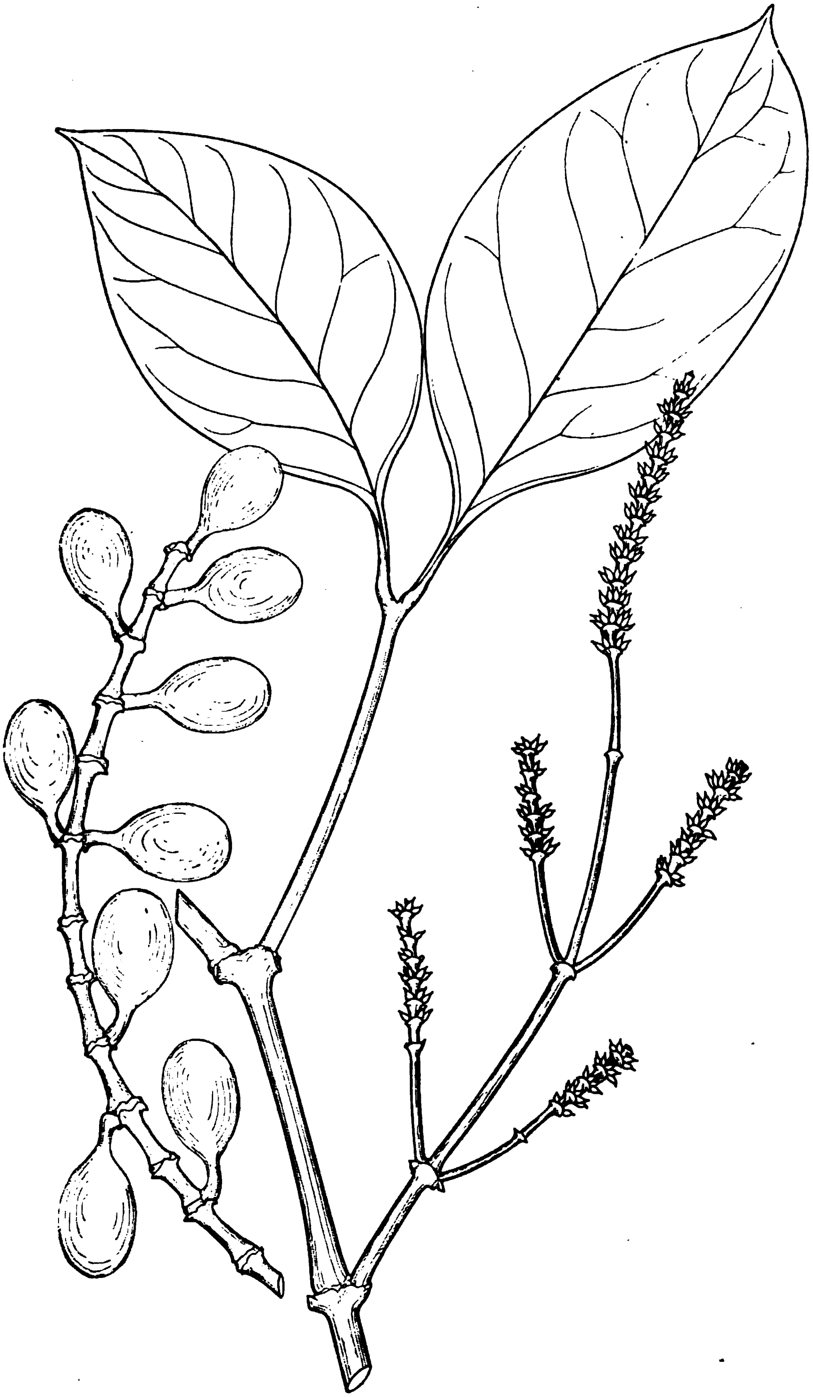

FIGURE 6. GNETUM INDICUM. ×½.

This plant grows submerged in salt water, and in some parts of the Philippines is abundant in the shallow waters of sheltered bays. It is distributed from Luzon to Mindanao.

Genus OTTELIA

OTTELIA ALISMOIDES Pers. KALABÓA.

Local names: *Espáda* (Spanish-Filipino); *kalabóa* or *kalabúa* (Bulacan, Rizal); *lantén-sápa* (Bataan); *lantíng* (Camarines); *tarabang* (Ilocos Norte).

Filipino children eat the fruit of this plant, and in some parts of the Archipelago the petioles and leaves are used as a vegetable.

Ottelia alismoides is an herb growing in fresh water. The leaves are extremely variable and have short or long petioles according to the depth of the water. The blades of the submerged leaves are often narrow; of the floating ones, ovate or somewhat rounded, with a rounded or heart-shaped base. They are 5 to 20 centimeters long and wide. The flowers are white and about 2 centimeters in length, the fruit oblong and from 2.5 to 4 centimeters long.

This species is distributed throughout the Philippines in shallow lakes and slowly running streams.

Genus VALLISNERIA

VALLISNERIA GIGANTEA Graebn. SABUTÁN-BUÁIA.

Local names: *Bal-liba* (Pangasinan); *sabután-buáia* (Rizal).

The younger leaves of this species are cooked and eaten as a vegetable.

Vallisneria gigantea grows submerged in fresh water and is characterized by long, ribbon-like leaves. The length of the leaves varies from a few centimeters to 2 meters or more, according to the depth of the water. They are thin and 1 centimeter or less in width.

This species is common and widely distributed throughout the Philippines in shallow lakes and slowly running streams.

Family GRAMINEAE

The young shoots of many of the bamboos are cooked and eaten as a vegetable. The bamboos are discussed in a separate bulletin.

Genus COIX

COIX LACHRYMA-JOBI L. var. **MA-YUEN** (Roman.) Staff. ILÁS.

This variety of *Coix lachryma-jobi* is characterized by the covering around the seed being thin and rather soft in texture. It is cultivated to a very limited extent in the Philippines where,

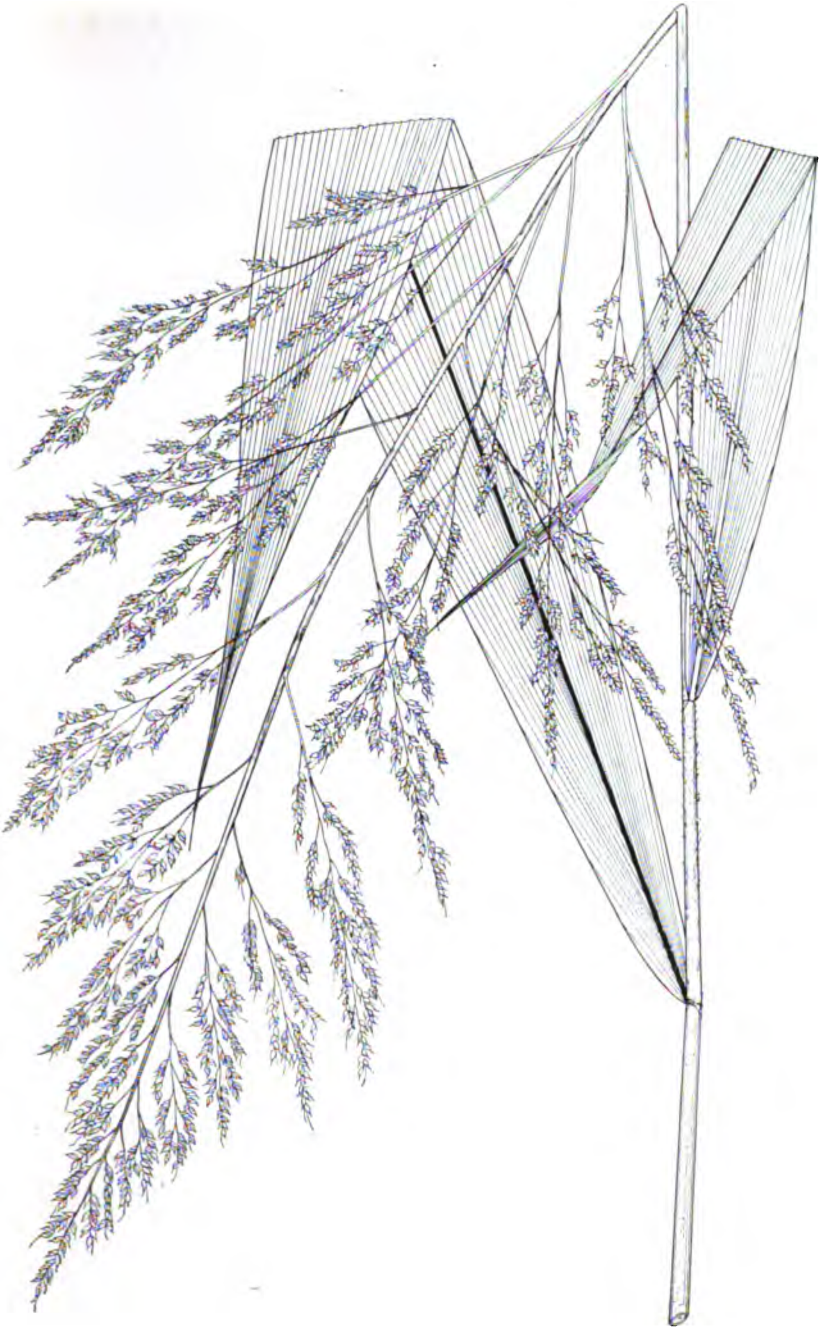

FIGURE 7. PANICUM PALMAEFOLIUM (AGUSAHIS). ×⅓.

as in India, the cultivation appears to be confined to the hill people. The seeds are prepared in various ways, and used for food and in the manufacture of fermented drinks. Blanco (1837) states that the Chinese gathered the fruits in large quantities in the provinces of Laguna and Pangasinan, and prepared from them a kind of flour which was reputed to be excellent for people in delicate health. This use of the seeds now appears to be obsolete, or at most must be local and limited.

Genus PANICUM

PANICUM PALMAEFOLIUM Koen. (Fig. 7). AGUSÁHIS.

Local names: *Agusáis, agusáhis* or *hagusáhis* (Camarines); *yas* (Benguet).

During times of scarcity the grains of this grass are used in Camarines and by the Ilokos as a substitute for rice. The grain is harvested and then roasted in a large pot. After roasting it is husked by pounding. The glumes are then removed and the seeds are cooked with sugar.

Panicum palmaefolium is a grass 1 to 3 meters in height. The leaves are 2 to 8 centimeters in width and longitudinally folded. The seeds are about 3 millimeters long and are borne in large numbers on terminal shoots.

This species is common and widely distributed from Luzon to Mindanao.

Family CYPERACEAE

Genus ELEOCHARIS

ELEOCHARIS DULCIS (Burm. f.) Trin. (Fig. 8). APÚLID.

Local name: *Apúlid* (Tagalog, Bikol).

The tubers of this species are dark colored, 2 to 2.5 centimeters in diameter, and are boiled and eaten as a vegetable. They are sold in large numbers in the Manila markets during the months of October to December.

Eleocharis dulcis is a tufted sedge with round, green stems, the bases of which are usually pale and covered with dry, brown sheaths. The stems are about a meter in height, about a centimeter in diameter, and are bluntly terminated by an erect spike, which is 2 to 3 centimeters in length. The bracts of the spike are rounded, smooth, and overlapping.

This species is of local occurrence in the Philippines and is found in open, wet places and in shallow water.

Family PALMAE

The palms are discussed in a separate bulletin.

The young seeds of *Nipa, Corypha elata* (buri), and *Arenga pinnata* (sugar palm) are employed as food, chiefly in the form

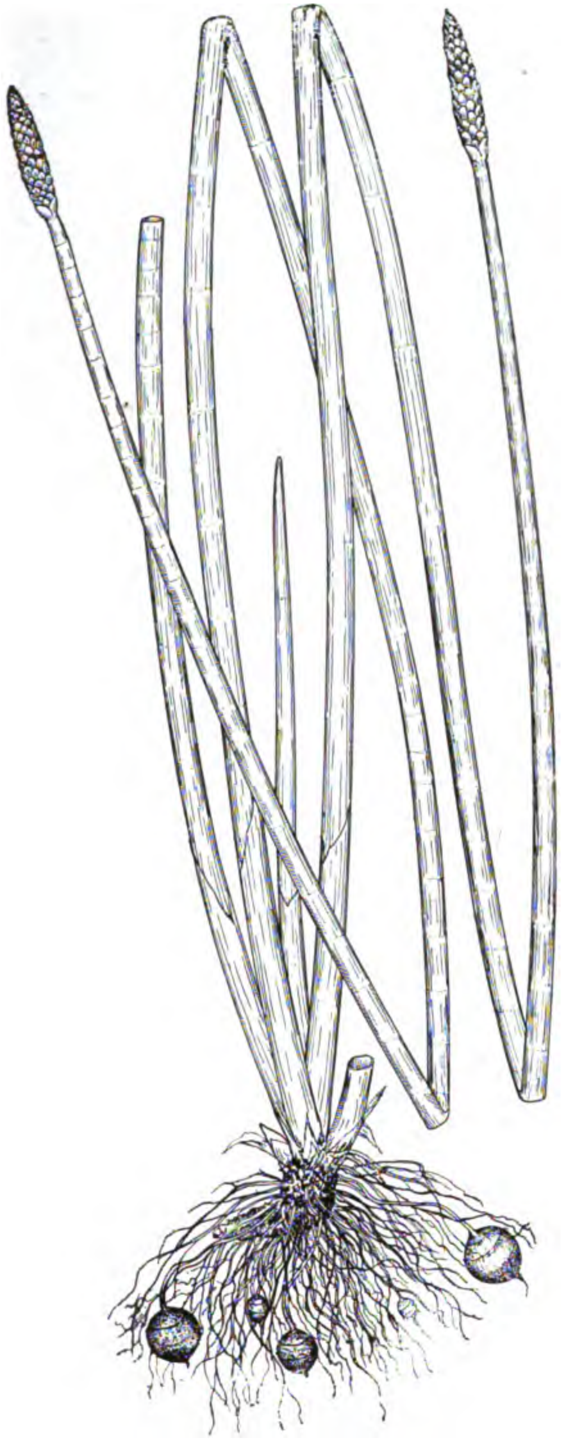

FIGURE 8. ELEOCHARIS DULCIS (APULID). ×⅓.

of sweetmeats. The stems of some species of *Calamus* have a swollen, basal portion containing starch. This is eaten by woodsmen. The bud (locally called úbud) of most palms is edible. In the Philippines the buds of the following are known to be used for foods: *Areca catechu* (betel nut), *Arenga ambong, Arenga pinnata* (sugar palm), some species of *Calamus* (rattans), *Cocos nucifera* (coconut), *Corypha elata* (buri), *Heterospathe elata,* and probably all other species of *Heterospathe, Metroxylon sagu* (sago palm), the different species of *Livistona* (anahau), and *Oncosperma* (anibong). The buds of many other palms are certainly edible. The most valuable palm from the standpoint of food is the coconut (*Cocos nucifera*).

Alcoholic drinks are manufactured from the sap of *Nipa fruticans, Cocos nucifera, Corypha elata, Arenga tremula,* and *Metroxylon sagu,* while an inferior product is made from *Areca caliso* and some species of *Caryota.*

Vinegar is produced from the sap of *Nipa fruticans, Arenga pinnata, Cocos nucifera,* and *Corypha elata.*

Starch is obtained from the stems of *Corypha elata, Arenga pinnata,* and *Metroxylon rumphii,* and sometimes from species of *Caryota.*

Sugar is produced from the sap of *Arenga pinnata* and *Corypha elata.* The *Nipa* palm is a very promising commercial source of sugar, while the juice of *Corypha,* used in connection with that of sugar cane, might also be a commercial possibility.

Syrup is manufactured from the sap of *Corypha elata.*

Some of the species of *Calamus* (rattan) contain water utilized for drinking purposes.

The nut of *Areca catechu,* sprinkled with lime and wrapped with the leaf of *Piper betle* (ikmo), is called buyo and is used for chewing. Various other palm nuts are sometimes substituted for those of *Areca catechu.* These include *Adonidia merrillii, Areca caliso, Areca ipot, Heterospathe elata, Oncosperma* and *Pinanga.*

Family ARACEAE

Genus ACORUS

ACORUS CALAMUS L. **LUBIGÁN.**

A description of this species and its local names are given in the bulletin on resins, gums, and oils.

This species is used as a condiment.

Genus ALOCASIA

ALOCASIA MACRORRHIZA (L.) Schott. BÍGA.

Local names: *Badiáng* (Occidental Negros, Cuyos); *bagiáng* (Bisaya); *bíga* or *bigá* (Bulacan, Pangasinan, Pampanga, Manila, Laguna, Camarines, Samar, Leyte, Mindoro, Romblon, Oriental and Occidental Negros, Capiz, Iloilo); *biga-bíga* (Manila); *bíra* (Ilocos Norte, Cagayan, Pangasinan); *gábi* (Manila, Camarines, Cavite, Tayabas, Batangas); *galiáng* (Bisaya); *gandús* (Pampanga); *malabíga* (Bataan); *palauán* (Occidental Negros); *ragiáng* (Bisaya); *sinín-ába* (Ilocos Norte); *taliáng* (Bisaya).

The stems and corms of this plant are utilized to some extent in the Philippines as food. They contain numerous, needle-like crystals, which are destroyed by roasting or boiling. However, they are little used as food, except when better kinds are scarce. The food value is due to the starch content, which is apparently small. Quisumbing,* who studied the corms of a two-year old plant, reported that the percentage of starch when the stems were fresh was 2.75, and when dry 18.80.

The leaves and petioles of this plant also contain minute, stinging crystals. As the plant is common in towns, being frequently planted for ornamental purposes, children sometimes take portions of the leaves or petioles into their mouths with rather painful results. The remedy indicated in such cases is vinegar or lemon juice.

Alocasia macrorrhiza has large, arrow-shaped leaves and a rather large trunk. It is exceedingly variable in size, depending on its habitat and the age of the plant.

This species is widely distributed in the Philippines. It occurs in open, wet lands, along streams, and in some types of humid forests.

Genus AMORPHOPHALLUS

AMORPHOPHALLUS CAMPANULATUS (Roxb.) Blume. (Figs. 9, 10). PUÑGÁPUNG.

Local names: *Anto, oroi, pamangkílon* (Bisaya); *bágang* (Cagayan); *bagóng* (Camarines, Jolo); *puñgápung, ápong, túkud-láñgit* (Tagalog); *tige ñga nagmanto* (Pangasinan); *tókod-bánua* (Pampanga).

The petioles of this plant are frequently boiled for feeding hogs. The corms, cut into slices and boiled, are also used for hog food. The leaves and corms contain very numerous, stinging crystals, which are destroyed by boiling. In some districts, in times of scarcity, this plant is utilized to a slight extent as human food.

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* Quisumbing, F. A., The cultivated root-producing aroids. Philippine Agriculturist and Forester, Volume 3 (1914), pages 85 to 98.

The petioles of *Amorphopallus campanulatus* are rough and mottled. The blades are divided into numerous lobes. The "flower" is dull purple and up to 30 centimeters in diameter. It emits a very offensive odor, similar to that of putrid meat. This odor attracts flies, which pollinate the plant.

This species is widely distributed at low and medium altitudes in the settled areas of the Philippines.

Genus CYRTOSPERMA

CYRTOSPERMA MERKUSII Schott. PALAUÁN.

Local name: *Palauán* (Bisaya); *galiáng* (Bikol).

The large, starchy rootstocks are eaten when food is scarce, and in some regions are a staple vegetable.

Cyrtosperma merkusii is an herbaceous plant with very large leaves and large, purplish "flowers". The petioles are up to 2.5 meters in length and 10 centimeters in diameter. The leaves are up to 1.5 meters in length.

This species is found in the central and southern Philippines, in wet ravines. It is also grown to a limited extent in the Visayan Islands and is quite commonly cultivated in Camarines.

Genus PISTIA

PISTIA STRATIOTES L. KIÁPO.

Local names: *Alulúan* (Cagayan); *dagailó* (Agusan); *darahiró, daraidó, darairó* (Bikol); *kayápo* (Bisaya); *lolóan* (Iloko); *kiápo* (Tagalog).

This plant is sometimes used for feeding hogs. For this purpose it is boiled, to destroy the minute, stinging crystals which are very abundant in the leaves. It is never cultivated in the Philippines. Ridley states that in Singapore it is commonly grown in small ponds by the Chinese, who use it for feeding hogs. Mercado states that it can be used with soap for removing stains from clothing; and that vessels which have contained oil can be cleaned and purified by filling them with water and kiápo plants, allowing this mixture to remain in the vessel a few days, and then scrubbing the interior with the plant.

Pistia stratiotes occurs in great abundance on the surfaces of stagnant water and slowly moving streams. The leaves are produced in a rosette, which gives the plant an appearance something like that of ordinary lettuce.

This species is common and widely distributed at low and medium altitudes in the Philippines.

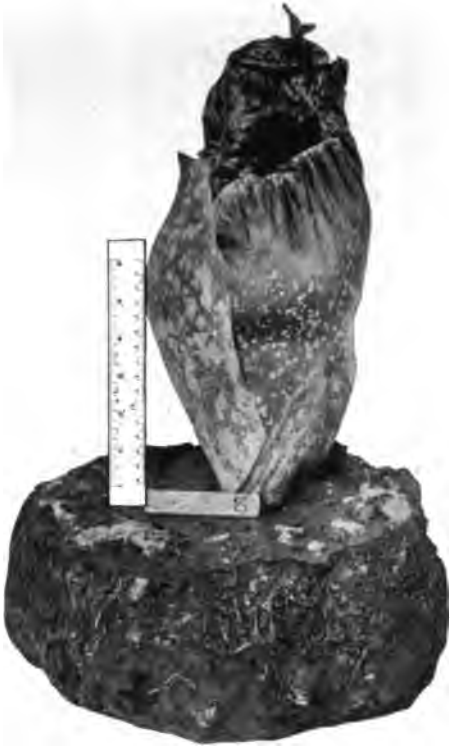

FIGURE 9. AMORPHOPHALLUS CAMPANULATUS (PUNG̃APUNG) WITH FLOWER BUD.

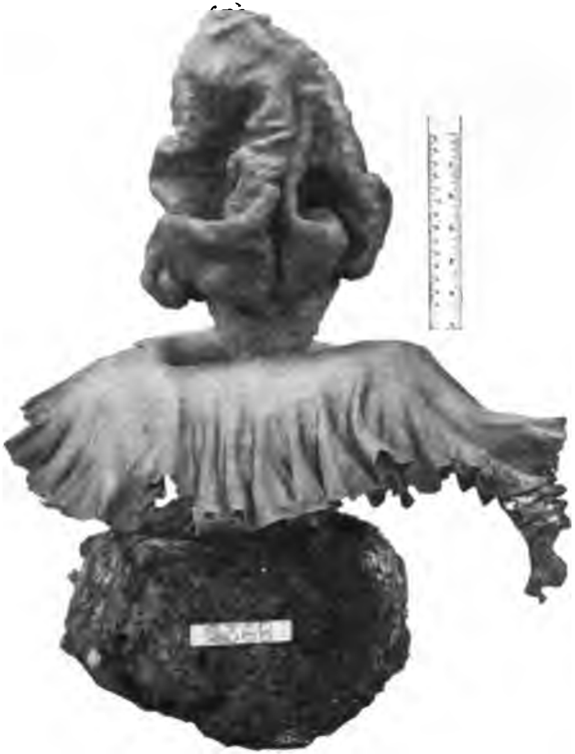

FIGURE 10. AMORPHOPHALLUS CAMPANULATUS (PUNG̃APUNG) WITH FULLY OPENED FLOWER.

Genus SPATHIPHYLLUM

SPATHIPHYLLUM COMMUTATUM Schott.

Koorders states that in Celebes the young leaves of this plant are cooked and eaten as a vegetable. This use is not reported from the Philippines.

Spathiphyllum commutatum is an herb about 1 meter in height. It has large leaves and large, white "flowers."

Family BROMELIACEAE

Genus ANANAS

ANANAS COMOSUS (Linn.) Merr. PINEAPPLE.

In some parts of the Philippines, particularly in parts of Palawan, the pineapple has become thoroughly naturalized.

Family TACCACEAE

Genus TACCA

TACCA PINNATIFIDA Forst. YABYÁBAN.

Local name: *Yabyában* (Manila vicinity).

This plant has somewhat rounded or oval tubers up to 8 centimeters in diameter, perhaps larger in rich soil. Bacon [*] found that the tubers yielded 22.3 per cent of starch and commented on the great ease with which the starch could be obtained in a pure state. It is known in commerce as Polynesian or East Indian arrowroot starch. The plant is, however, apparently little utilized in the Philippines at the present time, and is never cultivated. Blanco states that formerly very white Tacca flour or starch was brought to Manila in considerable quantity, and formed an agreeable food when eaten with sugar and that, mixed with white flour, it was used in making bread. In preparing the flour, the Filipinos rub the tubers under water with a rough stone, allow the starch to settle, pour out the water, and then dry the product. The starch must be washed several times to eliminate the bitter principle found in the fresh tubers. In some parts of Polynesia, India, and in parts of tropical Africa, *Tacca pinnatifida* is an important food plant and considerable attention is given to its culture.

Tacca pinnatifida is a large, coarse herb. The petioles are 1.5 to 2 centimeters in diameter and often nearly a meter in length. The leaves are 1 to 1.5 meters in diameter and divided into three parts, which are again divided. The flowers are green and purplish. The fruit is ellipsoid or ovoid, smooth, yellowish, six-ribbed, and 3 to 4 millimeters in length.

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[*] Bacon, R. F., Starch production of the Philippine Islands. Philippine Journal of Science, Volume 3 (1908), page 96.

This species is widely distributed near the seashore in the Philippines.

Family DIOSCOREACEAE

Genus DIOSCOREA

DIOSCOREA DIVARICATA Blco. KIRÓI.

Local names: *Buloi* (Bataan); *duyan* (Pangasinan); *kirói* (Tagalog); *ubog* (Rizal).

The underground tubers are fleshy, slender, and attain a length of over 2 meters. They are of a fair quality either baked or boiled.

Dioscorea divaricata is a vine with slender stems armed with scattered, short spines. The leaves are somewhat spear-shaped and usually 10 to 18 centimeters in length. The flowers are very small, yellowish green, and are borne on axillary inflorescences. The fruit is divided into three narrow, semi-circular lobes, which are about 2 centimeters wide and long, and contain flat, winged seeds.

This species has been reported from Pangasinan, Bataan, Rizal, and Laguna. It is not cultivated.

DIOSCOREA ESCULENTA (Lour.) Burkill. YAM OR TUN͠GÓ.

Local names: *Anég* (Cagayan); *boga* (Union); *kamíging* (Camarines); *tugí* (Tayabas); *ton͠gó* or *tun͠gó* (Bulacan, Manila, Rizal).

The tubers of this species are prepared like potatoes. There are apparently several varieties, and the best of them are considered excellent.

Dioscorea esculenta is a thorny, climbing vine. The leaves are somewhat kidney-shaped at the base, pointed at the tip, and somewhat hairy, the young ones densely so beneath. The roots are protected by thorny, subterranean branches. The flowers are green, about 4 millimeters in diameter, and are borne on long, slender spikes, which usually occur singly in the axils of the leaves.

This species is generally distributed throughout Luzon and is found in the Batanes Islands. It is also cultivated to some extent, and the yield of tubers is said to be very satisfactory.

DIOSCOREA HISPIDA Dennst. NAMÍ.

Local names: *Kalút, kulót, korót* (Zambales); *karóte* (Zamboanga); *kayos* (Tayabas); *korót* (Samar, Leyte); *namí* (Mindoro, Rizal); *namó* (Camarines).

The tubers are poisonous, but are rendered edible by being sliced and kept in running water from 36 to 48 hours.

Dioscorea hispida is a climbing vine and is characterized by compound leaves with three very large leaflets. The young stems, petioles, and leaflets are hairy. The flowers are small, pale yellow, and are borne on compound inflorescences, which are usually large. The fruits are about 5 centimeters long and divided into three thin lobes, which are more than twice as long as wide.

This species is distributed from the Mountain Province of Luzon to Basilan. It is common in the central provinces of Luzon and also in the northern part of Mindanao. It is rarely cultivated.

DIOSCOREA LUZONENSIS Schauer. PAKIT.

Local names: *Aribu-bu, kamán͠gög* (Union); *kirini, mayatbang* (Rizal); *paket* or *pakit* (Laguna); *ubag* (Bulacan).

The long, slender, underground tubers are collected and prepared in the same manner as potatoes.

Dioscorea luzonensis is a twining vine with somewhat arrow-shaped leaves. The flowers are small, and occur on spikes which grow in clusters from the axils of the leaves. The fruits are divided into three thin, somewhat semi-circular lobes, and contain thin, winged seeds.

This species has been reported only from the island of Luzon and is found in the following provinces: Ilocos Norte, Bontoc, Lepanto, Union, Bulacan, Zambales, Rizal, Laguna, and Batangas. It is not cultivated.

DIOSCOREA PENTAPHYLLA L. LIMA-LIMÁ.

Local name: *Lima-limá* (Rizal, Manila vicinity); *sapang* (Bisaya).

The large, starchy tubers are eaten like potatoes.

Dioscorea pentaphylla is a vine growing from stout, underground tubers. The stems bear scattered, small spines. Small tubers are found in the axils of the leaves, which are compound, with usually five to seven leaflets. These are pointed at the tip, smooth or nearly so, and 8 to 15 centimeters long. The flowers are small, yellowish white, somewhat fragrant, and borne in large numbers on compound, axillary inflorescences.

This species is common and widely distributed in the Philippines, but is not extensively cultivated.

Family MUSACEAE

Genus MUSA

MUSA spp. WILD BANANA.

A number of wild bananas are eaten in the Philippines. The fruits are, however, full of seeds and much inferior to the cultivated varieties. The flowering bud of some varieties is also used as a vegetable.

Family ZINGIBERACEAE

Genus ALPINIA

ALPINIA PYRAMIDATA Bl. LANGKAUÁS.

Local names: *Langkauás* (Rizal, Camarines); *langkuás* (Bisaya, Manobo, Banuaon, Mangguangan); *pal-la* (Mandaya, Lanao).

The root is used as a condiment. Its flavor is similar to ginger, but much less pungent. It is also cooked with the sap of sugar cane or with honey and water to produce an intoxicating beverage.

Alpinia pyramidata is a coarse herb. The leaves are about 45 centimeters long, 8 centimeters wide, pointed at both ends, the upper surface smooth, and the lower hairy. The flowers are white, about 3 centimeters long, and borne on rather large, compound inflorescences.

This species is distributed from central Luzon to southern Mindanao, and is occasionally cultivated on a very small scale.

Genus CURCUMA

CURCUMA LONGA L. DILÁU.

A description of this species and its local names are given in the bulletin on resins, gums and oils.

The roots are commonly sold in the Manila markets, and are used as a condiment and for coloring food and other materials. The root of *Curcuma longa* is a stimulative aromatic, bearing some resemblance to ginger in its operation. In India it is much employed as an ingredient of curry powder.

According to Heyne,* in Java a flour is made from this plant in the same way as from cassava and arrowroot. It is used for all kinds of dainties.

Genus VANOVERBERGHIA

VANOVERBERGHIA SEPULCHREI Merr.

The fruit is sub-ellipsoid, 2 to 2.5 centimeters long, and edible. It contains numerous seeds, which are about 3 millimeters long.

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 1, page 209.

Vanoverberghia sepulchrei is an erect, coarse, smooth plant reaching a height of 4 meters. It has a strong anise-like odor. The rhizome is 5 centimeters in diameter, with a red exterior. The stems are up to 5 centimeters in diameter. The leaves are alternate and two-ranked. The lower are rather short, and increase in length toward the tip of the stem. The upper leaves are up to 40 centimeters in length and 10 centimeters in width. The inflorescence is terminal, with a flower-bearing portion up to 20 centimeters in length. The flowers are very numerous, about 4.5 centimeters long, pink outside and white within.

This species has been reported only from Bontoc and Capiz.

Family PIPERACEAE

Genus PIPER

The leaves of several species of *Piper* are used as substitutes for those of *Piper betle* for chewing with the seeds of *Areca catechu.*

PIPER UMBELLATUM var. SUBPELTATUM C.DC. KUBÁMBA.

Local names: *Bal-lai* (Bontoc); *kamámba* (Tayabas); *kubámba* (Bulacan, Rizal, Laguna, Capiz); *kuyo* (Davao); *pugapong* (Bukidnon).

The young leaves and spikes are boiled as a condiment with fish.

Piper umbellatum is a vine with large, alternate, thin, heart-shaped leaves. The flowers are very small, and are densely crowded on spikes which are about 10 centimeters in length.

This species is distributed from northern Luzon to the southern part of the Sulu Archipelago.

Family FAGACEAE

Genus CASTANOPSIS

CASTANOPSIS PHILIPPENSIS Vid. (Fig. 11).

Local names: *Batíng, bayuktuan* (Rizal); *talakátak* (Camarines); *ulá-yan* (Samar).

The fruit grows on spikes, and contains an edible, oblong nut up to 3.5 centimeters in length. The flavor resembles that of a chestnut.

Castanopsis philippensis is a tree which is usually 15 to 25 meters in height and reaches a diameter of 50 centimeters. The leaves are alternate, smooth, pointed at both ends, and from 4 to 15 centimeters long.

This species has been reported from Rizal, Camarines, Mindoro, Samar, and Leyte. It is apparently not abundant.

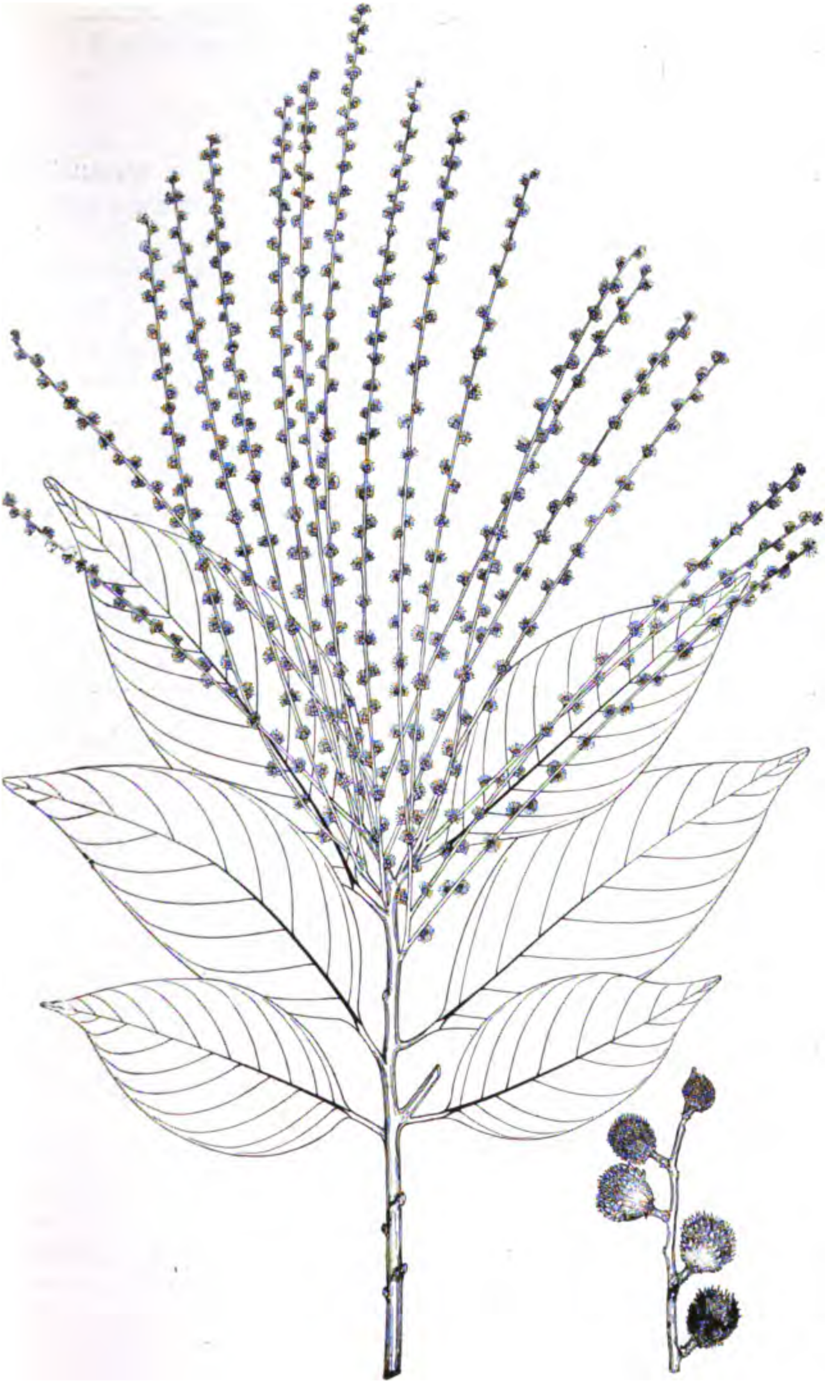

FIGURE 11. CASTANOPSIS PHILIPPENSIS. ×½.

There are several other species of this genus having edible nuts, but they are of little importance as a source of food.

Family MORACEAE

Genus ALLAEANTHUS

ALLAEANTHUS GLABER Warb. (Fig. 12). MALAMBÍÑGAN.

A description of this species and its local names are given in the bulletin on fibers.

The young leaves and flowers are cooked and used for food.

ALLAEANTHUS LUZONICUS F. Vill. HIMBABA-Ó.

Local names: *Anabó* (Masbate); *babáyan* (Zambales, Bataan); *bagli* (Moro); *buñgon* (Union); *himbaba-ó* (Pampanga, Rizal, Bataan, Manila, Cavite, Batangas); *lanéte* (Laguna, Tayabas).

The flowers and leaves when cooked are eaten as a vegetable.

Allaeanthus luzonicus is a tree reaching a height of 15 meters and a diameter of 30 centimeters. The leaves are alternate, pointed at the tip, and rounded at the base. The lower surface is very hairy. The flowers are very small, and are borne on very long, slender, spike-like, flowering branches.

Genus ARTOCARPUS

ARTOCARPUS COMMUNIS Forst. (Figs. 13, 14). BREADFRUIT or KAMÁNSI.

A description of this species and its local names are given in the bulletin on fibers.

This species has a large, ellipsoid fruit up to 20 centimeters in diameter, which contains ovoid or somewhat rounded seeds that are about 2.5 centimeters in diameter and edible.

Artocarpus communis is distributed throughout the Philippines, both cultivated and wild. There is a cultivated, seedless variety called rímas. The wild kind, known as antipólo, is inferior to the large seeded variety known as ugúb or kamánsi.

ARTOCARPUS ELASTICA Reinw. GUMÍHAN.

A description and figure of this species and its local names are given in the bulletin on fibers.

The fruit contains a sweet, edible pulp of fair or good quality, embedded in which are numerous seeds which are roasted and eaten like peanuts.

ARTOCARPUS INTEGRA (Thunb.) Merr. (Figs. 15, 16). NANGKÁ.

A description of this species and its local names are given in the bulletin on fibers.

The fruit is green, oblong, fleshy, and 25 to 60 centimeters in length. It is the largest known tree-fruit in the world, some-

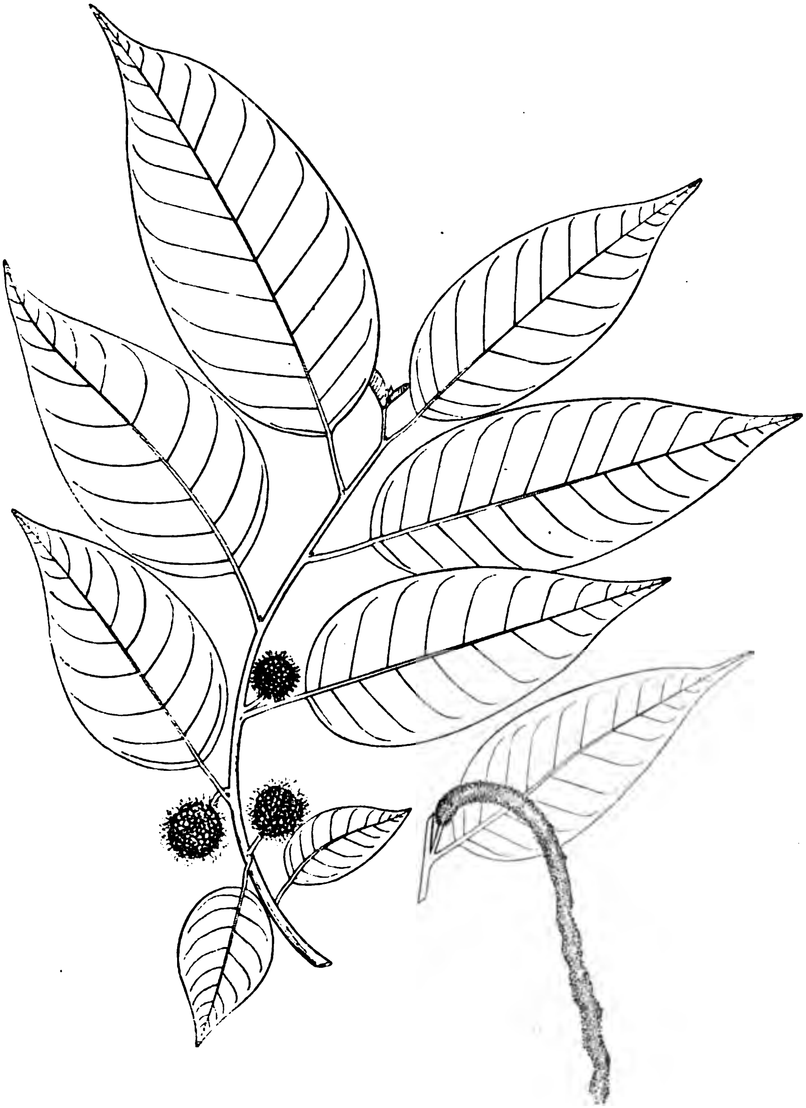

FIGURE 12. ALLAEANTHUS GLABER (MALAMBINGAN). X½.

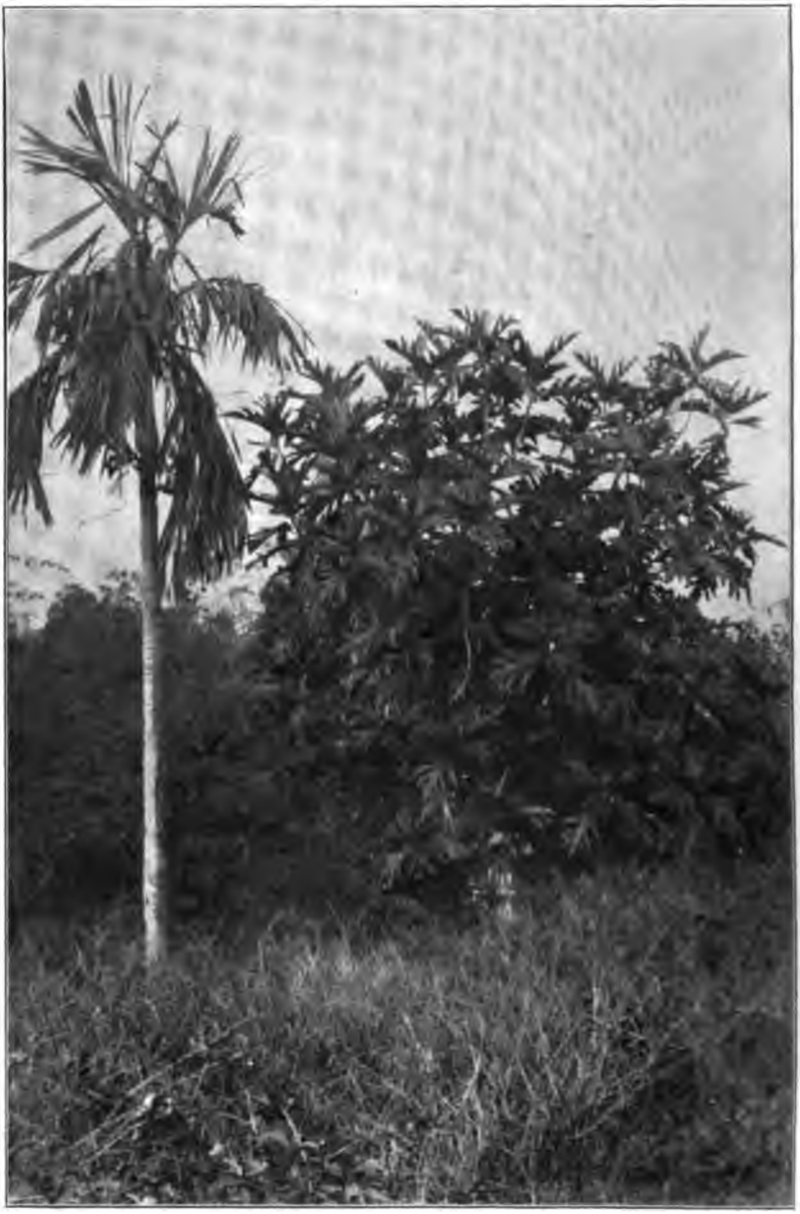

FIGURE 13. ARTOCARPUS COMMUNIS (BREADFRUIT OR KAMANSI).

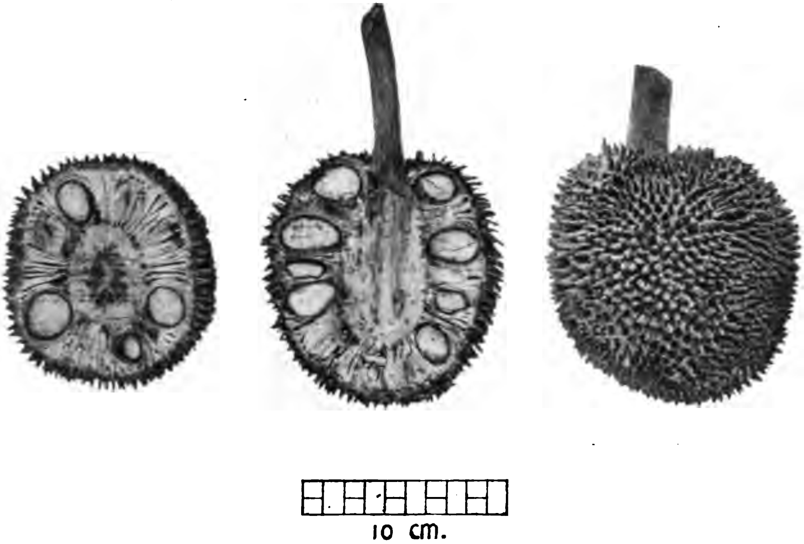

FIGURE 14. ARTOCARPUS COMMUNIS (BREADFRUIT OR KAMANSI).

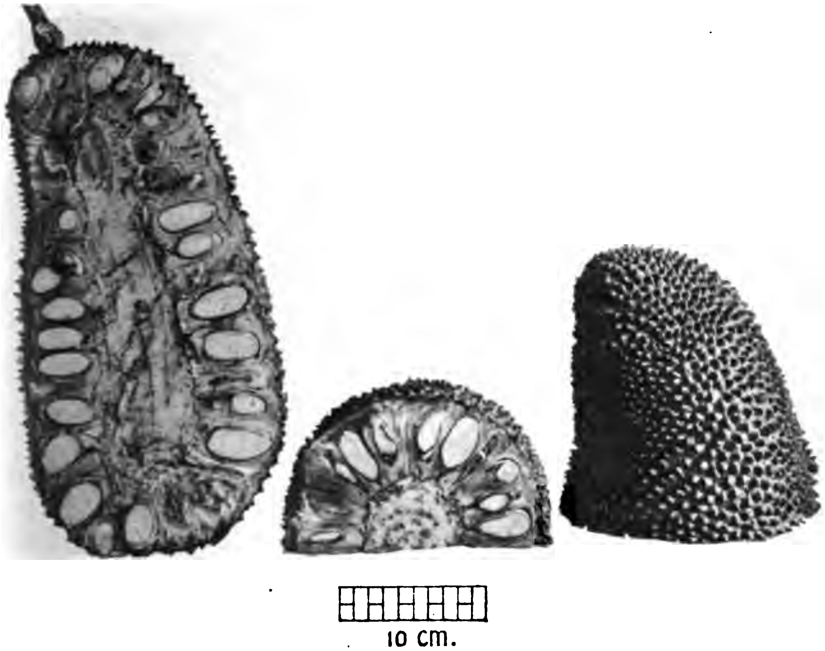

FIGURE 15. ARTOCARPUS INTEGRA (NANGKA).

times exceeding 35 kilos in weight. The flesh is rich yellow in color, sweet, and very aromatic. It makes good preserves and other sweets.

ARTOCARPUS ODORATISSIMA Blanco. (Fig. 17). MÁRANG.

Local names: *Márang* (Basilan, Davao, Zamboanga); *olói* (Mindoro).

The fruit of this species is very large; the flesh white, sweet, very rich, juicy, and aromatic.

Artocarpus odoratissima is a tree reaching a height of 12 to 25 meters and a diameter of 40 centimeters. The leaves are very rough, large, and entire or lobed.

This species has been reported only from Mindoro, Mindanao, and Basilan; but it is apparently fairly common in Mindoro, Cotabato, Lanao, Davao, Zamboanga, and Basilan.

Genus CONOCEPHALUS

CONOCEPHALUS VIOLACEUS (Blanco) Merr. HANÓPOL.

Local names: *Anópol* (Albay); *anúpol* (Tayabas); *bagauak, hanópol* (Rizal, Laguna, Camarines, Polillo); *kanúpul* (Tayabas); *tagimi* (Basilan).

When this vine is cut, water exudes in such copious quantities that it is used for drinking purposes and for cooking rice.

Conocephalus violaceus is a large vine with alternate leaves, which are pointed at the tip and usually rounded at the base. They are about 12 to 15 centimeters wide and 15 to 20 centimeters in length. The flowers are purple or white, and are borne in dense heads.

Genus FICUS

FICUS ULMIFOLIA Lam. (Fig. 18). ISÍS.

Local names: *Apas, kuplás* (Benguet); *apulás* (Bontoc); *asís* (Nueva Ecija, Batangas); *hagúpit* (Laguna); *isís* (Bataan, Laguna); *kikkig* (Cagayan); *pakiling* (Pampanga); *upling-gúbat* (Polillo); *upplás* (Benguet, Union, Babuyanes); *tabú* (Mindoro); *yayasi* (Batanes Islands).

The fruits are edible and have a good flavor, especially when eaten with sugar and cream. They are soft and fleshy when mature, orange red to purple, somewhat rounded, and about 1.5 centimeters long.

The leaves of this species are very hard and rough, and are used for cleaning cooking utensils and scouring hardwood floors, stairs, windowsills, etc.; and also in place of sandpaper for polishing wood, when sandpaper is not available.

Ficus ulmifolia is a shrub or small tree from 3 to 5 meters in height. The leaves are alternate, variable in shape, subentire, undulately lobed or coarsely toothed, sometimes deeply or narrowly lobed. The base is rounded and three-nerved. The

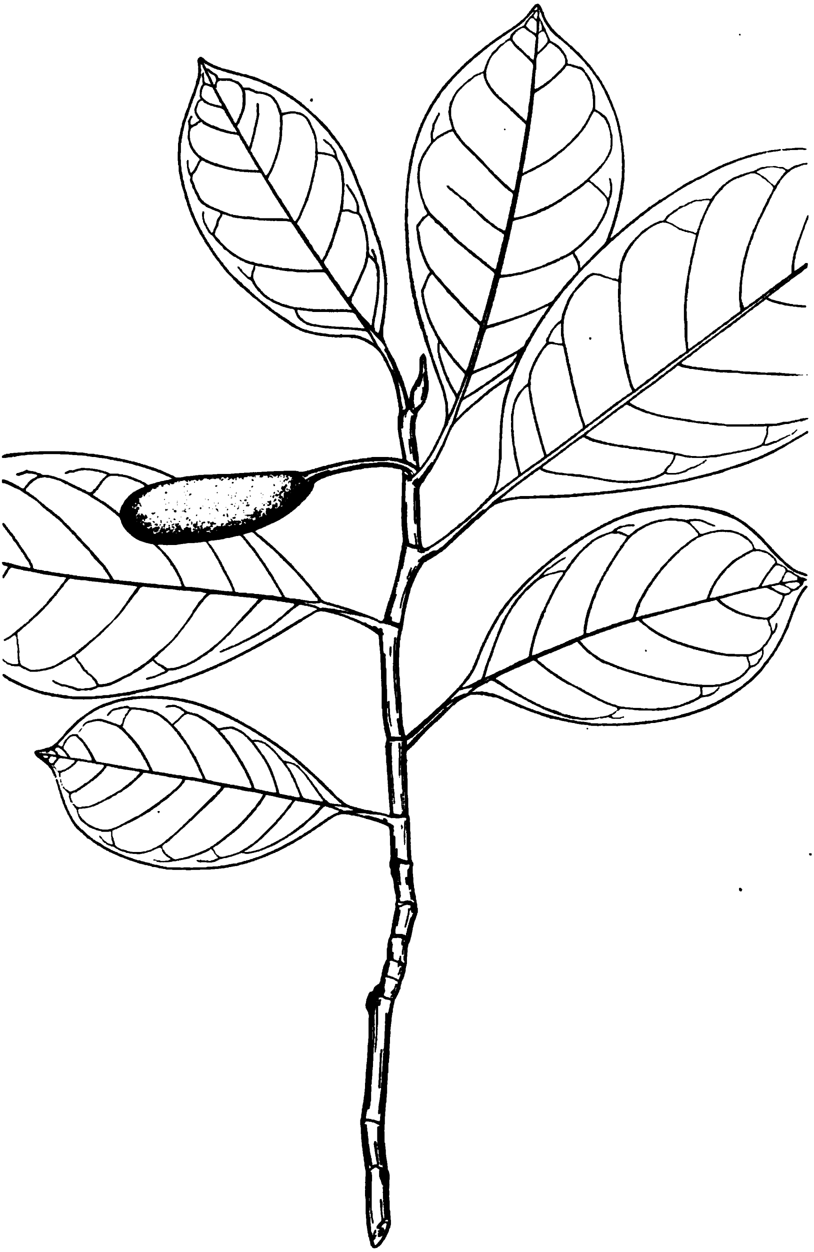

FIGURE 16. ARTOCARPUS INTEGRA (NANGKA). ×½.

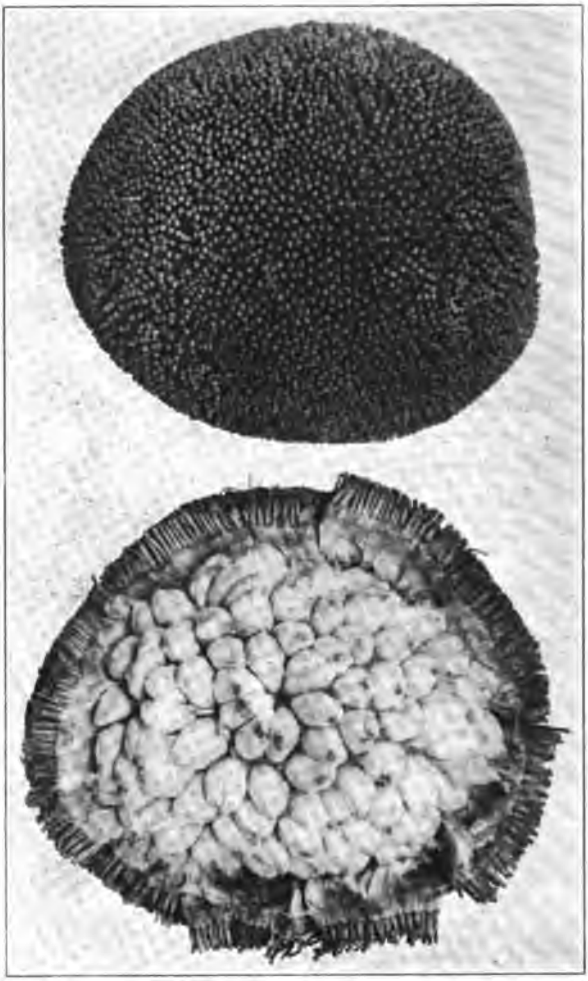

FIGURE 17. ARTOCARPUS ODORATISSIMA (MARANG).

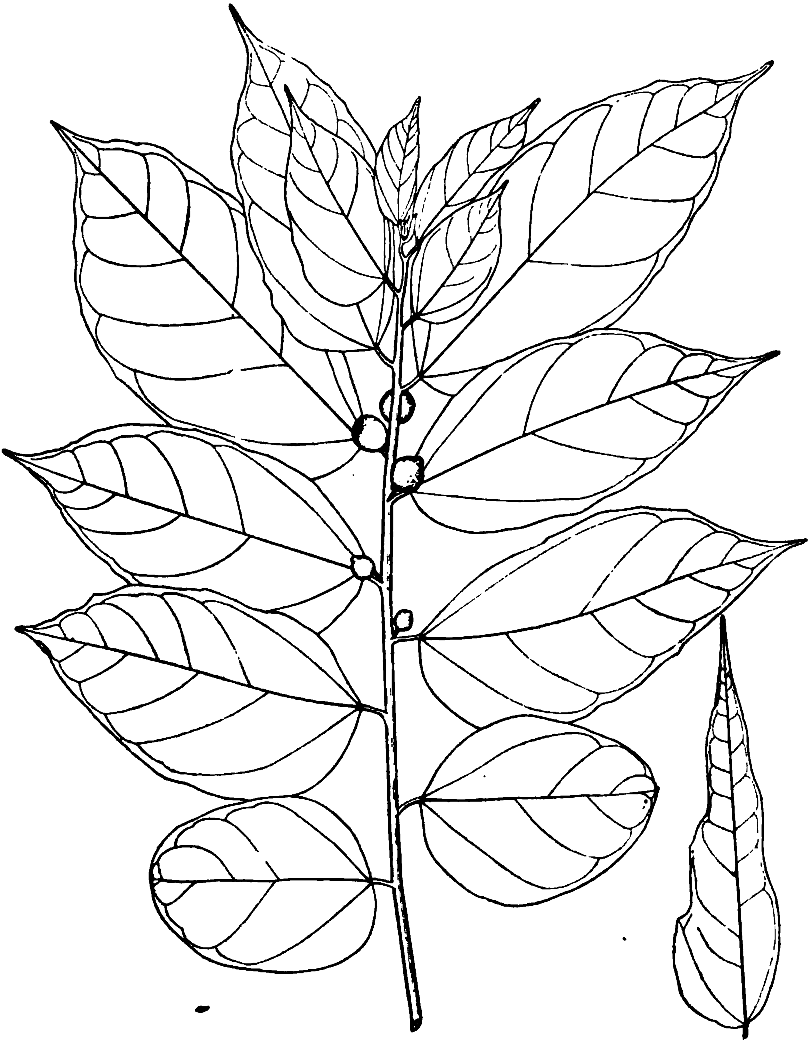

FIGURE 15. FICUS ULMIFOLIA (ISIS). ×½.

leaves are 9 to 17 centimeters long, and 4 to 8 centimeters wide. The fruits are axillary and solitary or in pairs.

This species is common in thickets and open places throughout the Philippines.

Genus GYMNARTOCARPUS

GYMNARTOCARPUS WOODII Merr. (Fig. 19). MALANANGKÁ.

Local names: *Anubing-kadiós, anubing na nangká* (Laguna); *bayukó* (Camarines); *bíga* (Samar); *buratu* (Cagayan); *malabokbók* (Zambales); *malanangká* (Bataan, Laguna); *páñgi* (Zambales); *sulípa* (Bataan); *tábulí* (Camarines).

The fruit of this species is somewhat rounded, 6 to 9 centimeters in diameter, and contains 6 to 12 chestnut-like seeds, 2 or 3 centimeters long. The seeds are eaten either roasted or boiled.

Gymnartocarpus woodii is a tree reaching a height of about 20 meters and a diameter of about 40 centimeters. The leaves are alternate, oblong, pointed at the tip, rounded or pointed at the base, 8 to 15 centimeters long, and 5 to 7 centimeters wide. The fruit, when dry, is irregularly and obscurely lobed.

This species occurs in central and southern Luzon, Mindoro, Samar, and Leyte.

Family URTICACEAE

Genus ELATOSTEMA

ELATOSTEMA Spp.

Some of the more fleshy members of this genus are cooked and eaten as greens.

Elatostema is a genus of small herbaceous plants which usually have soft, somewhat fleshy leaves. The leaves are three-nerved, alternate or with a minute leaf opposite each normal one. They occur on the stem in two rows and are almost or entirely without individual stems. The flowers are very small, and are crowded in dense, axillary heads.

Species of *Elatostema* are very common in moist forests throughout the Archipelago.

Family OLACACEAE

Genus ANACOLOSA

ANACOLOSA LUZONIENSIS Merr. (Figs. 20–22). GALÓ.

Local names: *Alluloi, malabignái* (Bataan); *galó* (Cavite); *castañas* (Span. in Mindoro); *matobató* (Masbate); *yu-pa* (Nueva Vizcaya).

This plant produces a nut which is of good quality and flavor.

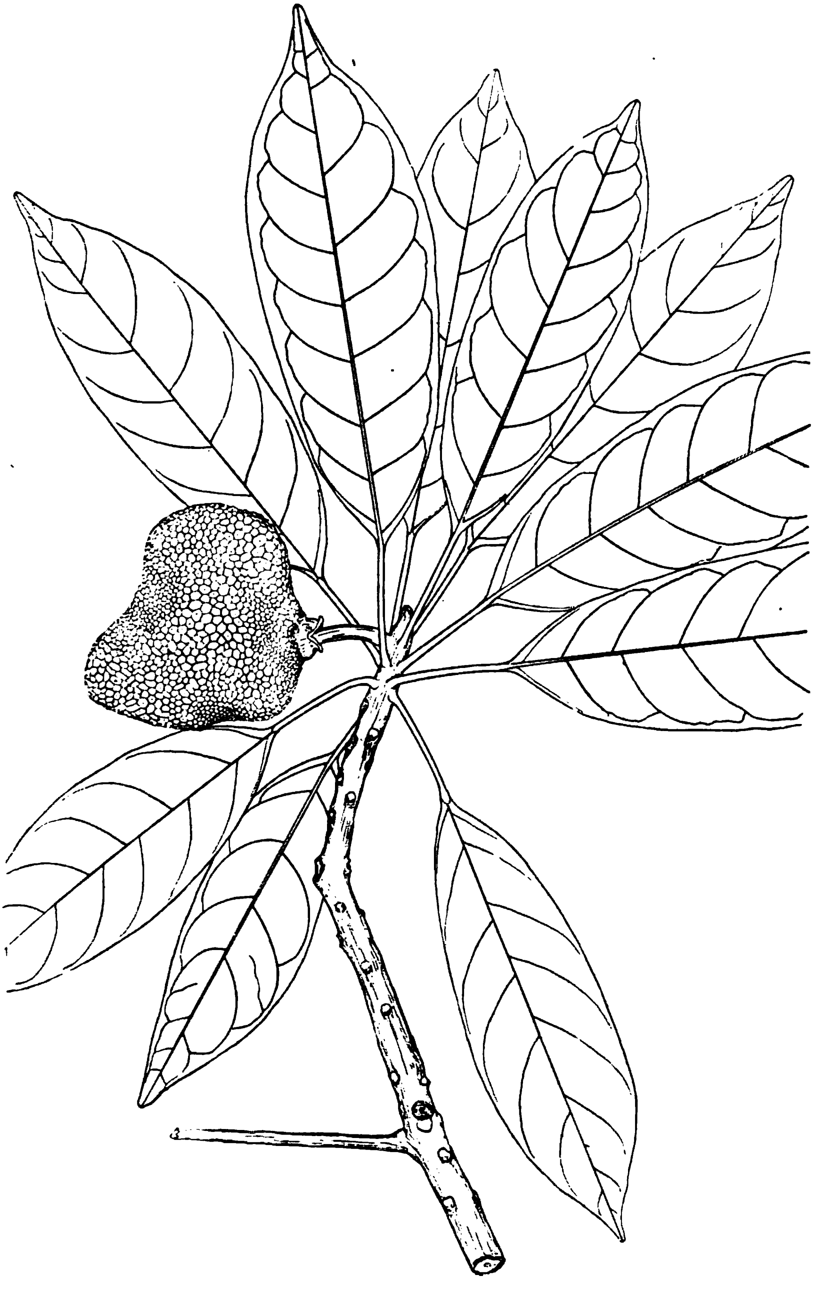

FIGURE 19. GYMNARTOCARPUS WOODII (MALANANGKA). ×½.

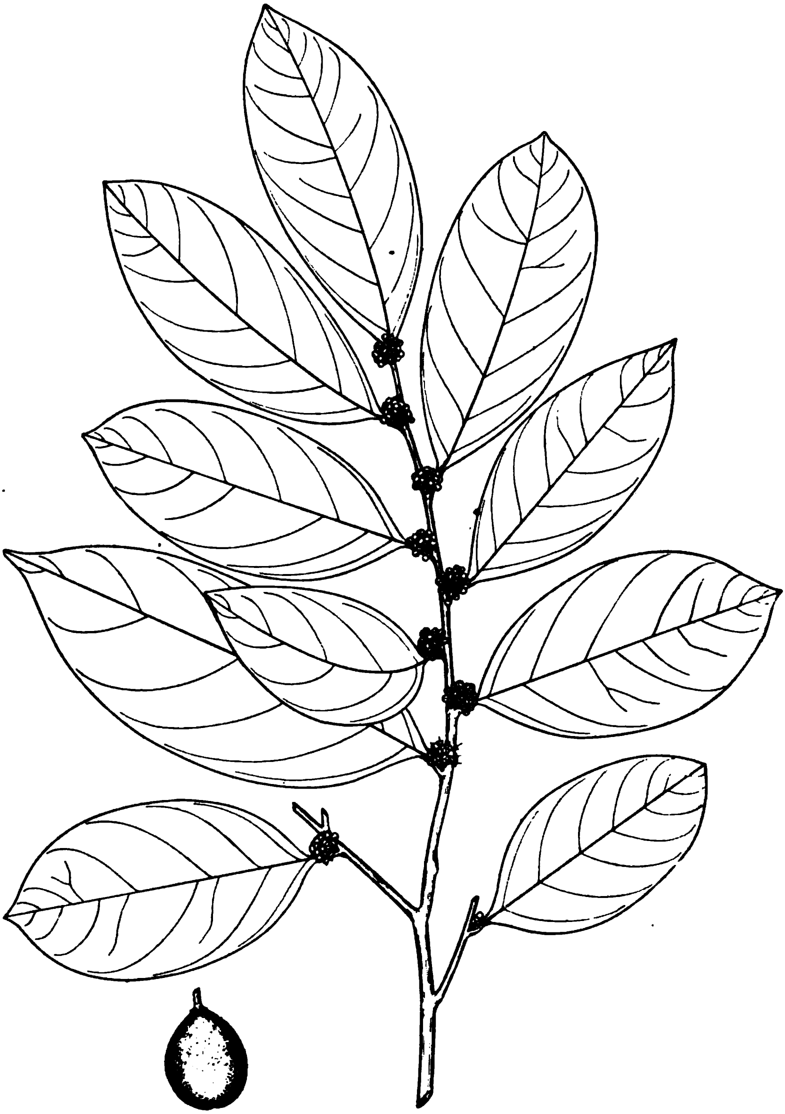

FIGURE 20. ANACOLOSA LUZONIENSIS (GALO). ×½.

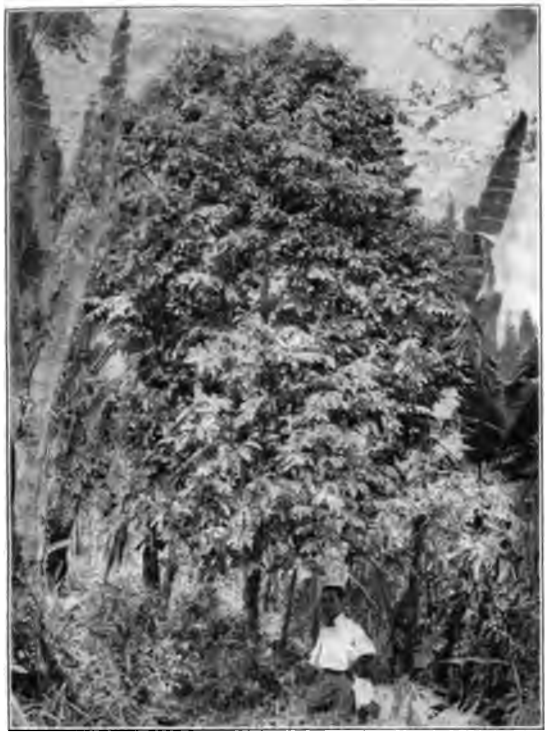

FIGURE 21 ANACOLOSA LUZONIENSIS (GALO).

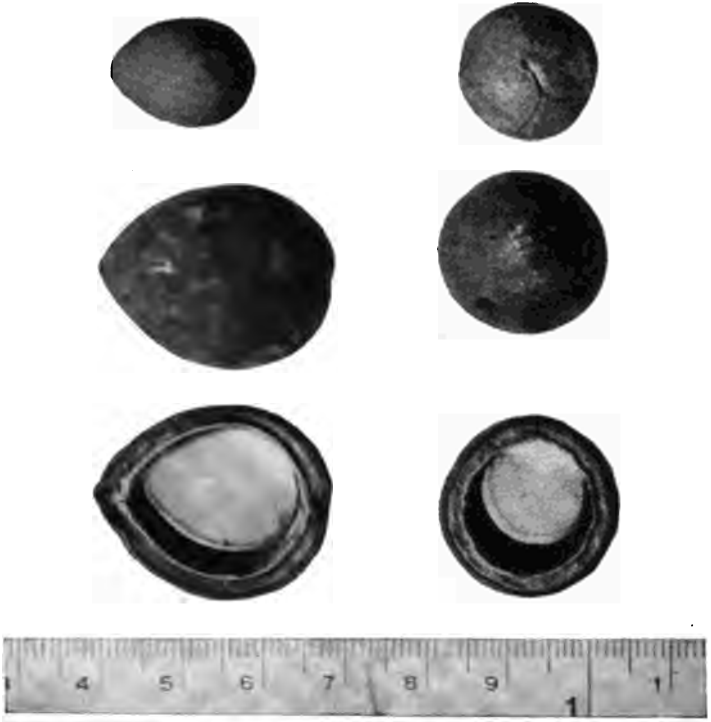

FIGURE 22. FRUIT OF ANACOLOSA LUZONIENSIS (GALO).

Anacolosa luzoniensis is a tree reaching a height of 15 meters or more, and a diameter of 50 centimeters. The leaves are alternate, and somewhat pointed at both ends. The flowers are small, yellow, and occur in small clusters.

This species has been reported only from Cagayan, Benguet, Nueva Vizcaya, Bataan, Cavite, Batangas, Mindoro, and Masbate. It is apparently rare and is never cultivated.

Genus XIMENIA

XIMENIA AMERICANA L. (Fig. 23).

Local names: *Bo-o* (Samal Island); *pangungan* (Basilan Island).

The fruits of this species taste like sour apples, and are eaten either fresh or pickled. The nuts are purgative. According to Heyne,* when cooked and powdered they are mixed with sago to make bread. The fruits are yellow, egg-shaped, and about 2 centimeters in diameter.

Ximenia americana is a spiny shrub about 3 meters in height. The leaves are alternate, elliptical, and about 5 centimeters in length. The flowers are less than a centimeter long, greenish white, and fragrant.

This species is distributed along the coast from Luzon to Mindanao and Palawan.

Family AMARANTHACEAE

Genus AMARANTHUS

AMARANTHUS VIRIDIS L. (Fig. 24). KULÍTIS.

Local names: *Bauan* (Bontoc); *kulítis* (Tagalog); *kadiapá* (Agusan); *kalúnai* (Camguin Island, Iloko, Pangasinan); *kilítis* (Bikol).

The leaves and young stems are boiled and eaten as a vegetable.

Amaranthus viridis is an erect, smooth, branched, unarmed annual, 30 to 60 centimeters in height. The leaves are broad at the base and narrow at the apex, which is usually notched. They are from 4 to 10 centimeters in length and have long petioles. The inflorescences occur in the axils of the leaves or at the ends of branches. The flowers are very small, densely crowded, green, and about 1 millimeter long. The seeds are small, and brown or black.

This species is common in open waste places throughout the Philippines.

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 2, page 92.

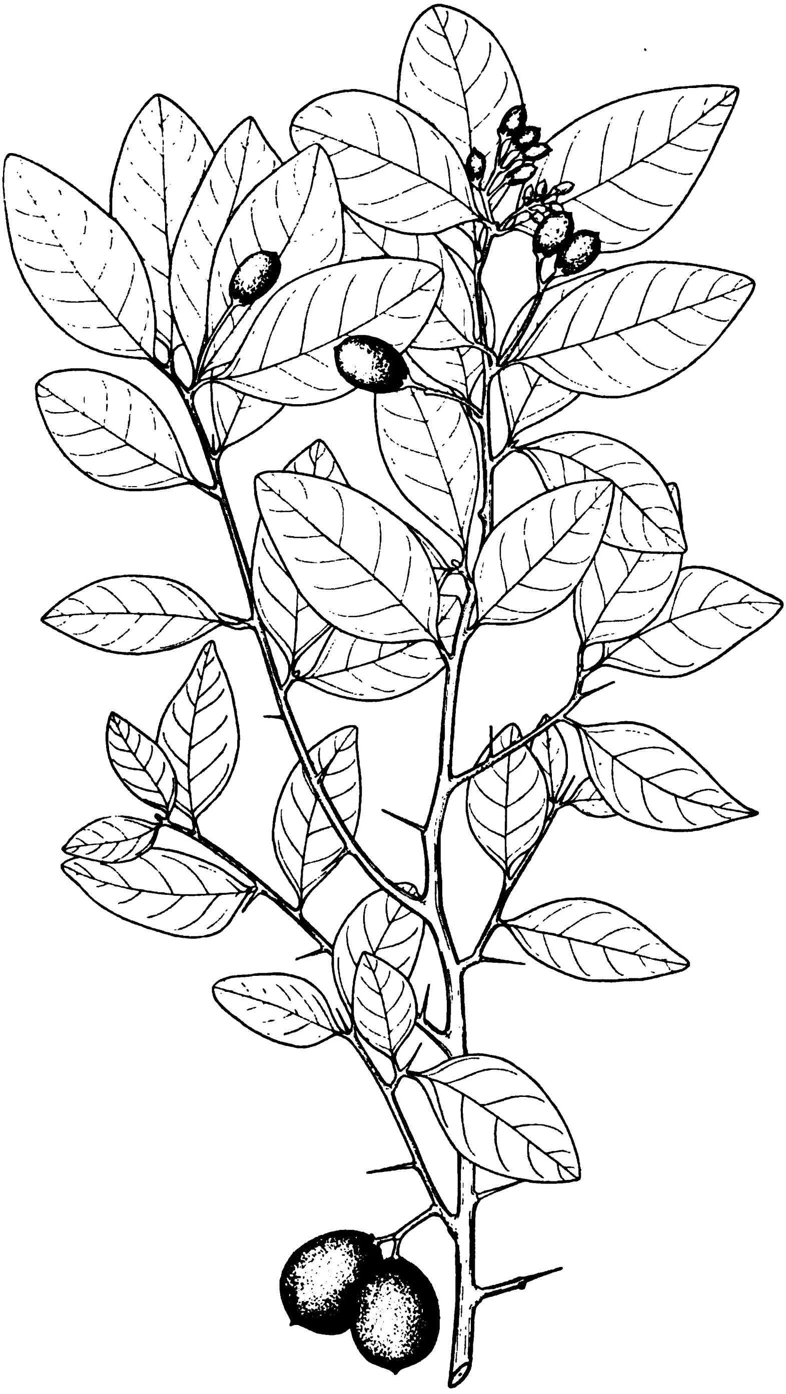

FIGURE 23. XIMENIA AMERICANA. ×⅔.

Family AIZOACEAE

Genus SESUVIUM

SESUVIUM PORTULACASTRUM L. **Dampalit.**

The stems and leaves when boiled are eaten as a vegetable.

Sesuvium portulacastrum is a fleshy, prostrate, spreading, branched herb. The stems root at the nodes, are often reddish, 20 to 50 centimeters in length, and have short, ascending branches. The leaves are narrow, very thick, fleshy, and 2 to 4 centimeters long. The flowers are small, and pink or red. The capsules are about 5 millimeters in length.

This species grows along the seashore throughout the Philippines.

Family PORTULACACEAE

Genus PORTULACA

PORTULACA OLERACEA L. **Gulasíman.**

Local names: *Gulasíman, sahikan* (Tagalog, Mindoro); *olasíman* (Leyte); *ausíman, gulasíman, ulasíman* (Camarines).

This plant is eaten as a vegetable. It is also used in many regions as food for hogs.

Portulaca oleracea is an annual, prostrate or spreading, smooth, branched herb, 10 to 50 centimeters in length. The stems are often purplish. The leaves are fleshy, flat, wedge-shaped at the base, and 1.5 to 2.5 centimeters long. The flowers are yellow and occur in few-flowered heads.

This species is very common in waste places throughout the Philippines.

Genus TRIANTHEMA

TRIANTHEMA PORTULACASTRUM L.

Local name: *Ulisúman* (Negros Occidental).

This plant is eaten as a vegetable.

Trianthema portulacastrum is a prostrate, smooth or slightly hairy, succulent, branched herb. The branches are up to 60 centimeters or more in length. The leaves are opposite, rounded at the tip, wedge-shaped at the base, and 1 to 5 centimeters long. The flowers are pink and 4 to 5 millimeters in length. The capsule is 5 to 6 millimeters long and contains about 10 small seeds.

This species is a common weed in and about towns, especially in recently disturbed soil.

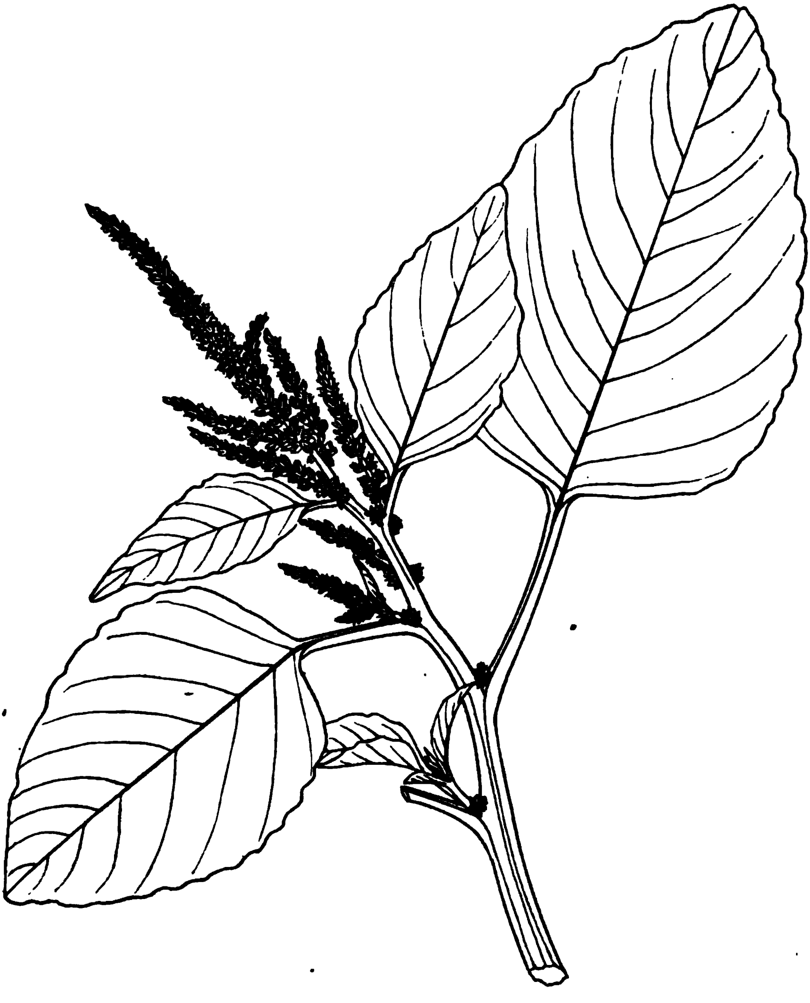

FIGURE 24. AMARANTHUS VIRIDIS (KULITIS). NATURAL SIZE.

Family BASELLACEAE

Genus BASELLA

BASELLA RUBRA L. LIBÁTO.

Local names: *Libáto* (Tagalog); *alogbáti* (Bisaya); *arogbáti* (Bikol).

The leaves of this species make a very good substitute for spinach.

Basella rubra is a juicy, branched, smooth, twining, herbaceous vine which reaches a length of about 10 meters. The stems are green or purplish. The leaves are somewhat fleshy, pointed at the tip, and 5 to 12 centimeters long. The flowers are pink, about 4 millimeters long, and are borne on spikes which grow in the axils of the leaves and are 5 to 20 centimeters long. The fruit is 5 to 6 millimeters long.

This species is found throughout the Philippines in waste places.

Family NYMPHAEACEAE

Genus NELUMBIUM

NELUMBIUM NELUMBO Druce. BÁINO or LOTUS.

Local names: *Báino'* (Tagalog); *béno'* (Laguna); *linga-ling* (Cagayan); *sana* (Cotabato).

The large seeds are contained in a cone-shaped structure, and when nearly mature are eaten either raw or roasted.

According to Crevost and Lemarié,* in Indo-China, the roots of this species are commonly sliced and eaten raw with meats.

Nelumbium nelumbo is a perennial, aquatic herb with large, rounded leaves and large, attractive, pink, red, or white flowers, which stand out of the water.

This species has been reported from Cagayan, Laguna, Albay, Camarines, Mindoro, Cotabato, and Davao. It is very common in some parts of Laguna de Bay. The flowers are sold in Manila.

Genus NYMPHAEA

NYMPHAEA PUBESCENS Willd. PULÁU.

Local names: *Láuas, puláu* (Laguna).

The fleshy rhizomes of this plant are eaten as a vegetable. The seeds are also used as food.

Nymphaea pubescens is a perennial, aquatic herb about 1.5 meters in height. The leaves arise from the base of the plant

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* Cat. Prod. de l'Indo-Chine, page 174.

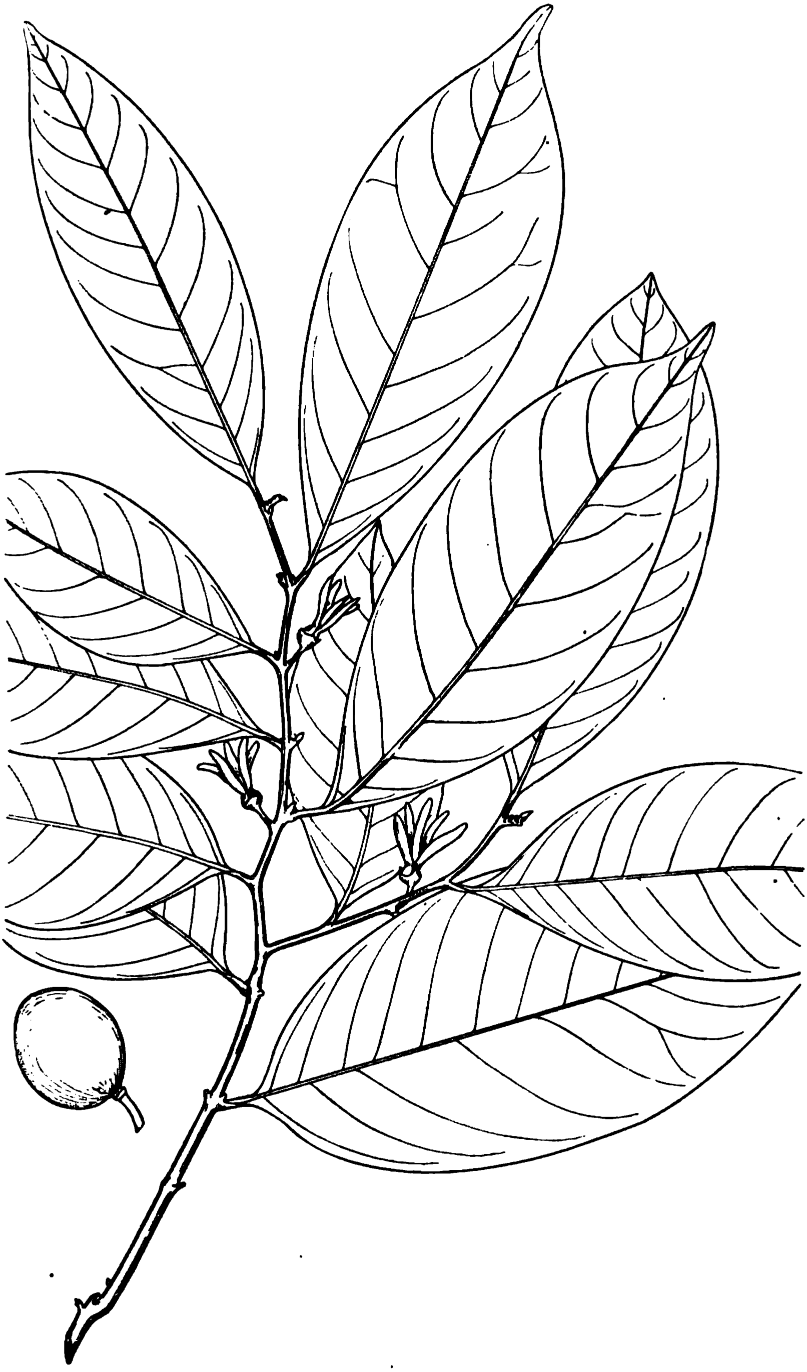

FIGURE 25. CYATHOCALYX GLOBOSUS (DALINAS). X½.

and are very large and prominently toothed. The flowers are very large. The petals are white, tinged with pink or yellow.

This species is widely distributed in the Philippines, being very abundant in some lakes.

Family ANNONACEAE

Genus CYATHOCALYX

CYATHOCALYX GLOBOSUS Merr. (Fig. 25). DALÍNAS.

Local names: *Alínau* (Ilocos Norte); *baniakáu* (Ilocos Sur); *bohókan* (Catanduanes); *dalínas* (Bataan); *damarau* (Negros); *ilang-ílang-gúbat* (Tayabas); *kutipi* (Union); *lanútan* (Bataan, Tayabas); *latauán* (Bataan); *malatapái* (Negros); *tapúlau* (Rizal).

The seeds of this tree are used by the Negritos as a substitute for areca nuts for chewing.

Cyathocalyx globosus is a tree reaching a height of about 30 meters and a diameter of about 40 centimeters. The fruits are somewhat rounded, and about 4 centimeters in length. The leaves are smooth, pointed at the apex, and rounded or somewhat pointed at the base.

Genus UVARIA

UVARIA PURPUREA Bl.

The fruits are aromatic and edible. They are borne in a cluster from a disk-shaped structure.

Uvaria purpurea is a woody vine. The leaves are alternate, hairy, pointed at the tip, somewhat rounded at the base, and 12 to 25 centimeters in length. The flowers are large and red.

This species is distributed from Luzon to Palawan, but is apparently rare.

UVARIA RUFA Blanco. (Fig. 26). SÚSUNG-KALABÁU.

Local names: *Al-lágat* (Pangasinan); *hinlalágak* (Rizal); *iníu* (Zambales); *súsung-kalabáu* (Bataan, Rizal, Batangas); *súsung-damúlag* (Pampanga); *súsung-kabáyo* (Marinduque Island).

The fruit is edible, and has an agreeable flavor.

Uvaria rufa is a climbing shrub, the younger parts of which are densely hairy. The leaves are alternate, hairy, pointed at the tip, somewhat heart-shaped at the base, and from 8 to 16 centimeters in length. The fruits are borne in rounded clusters, are oval, hairy, red, and usually about 1.5 to 2 centimeters in diameter. The fruit contains two rows of flat, semi-circular seeds.

This species is distributed from central Luzon to southern Mindanao. It is cultivated only at the Lamao Experiment Station.

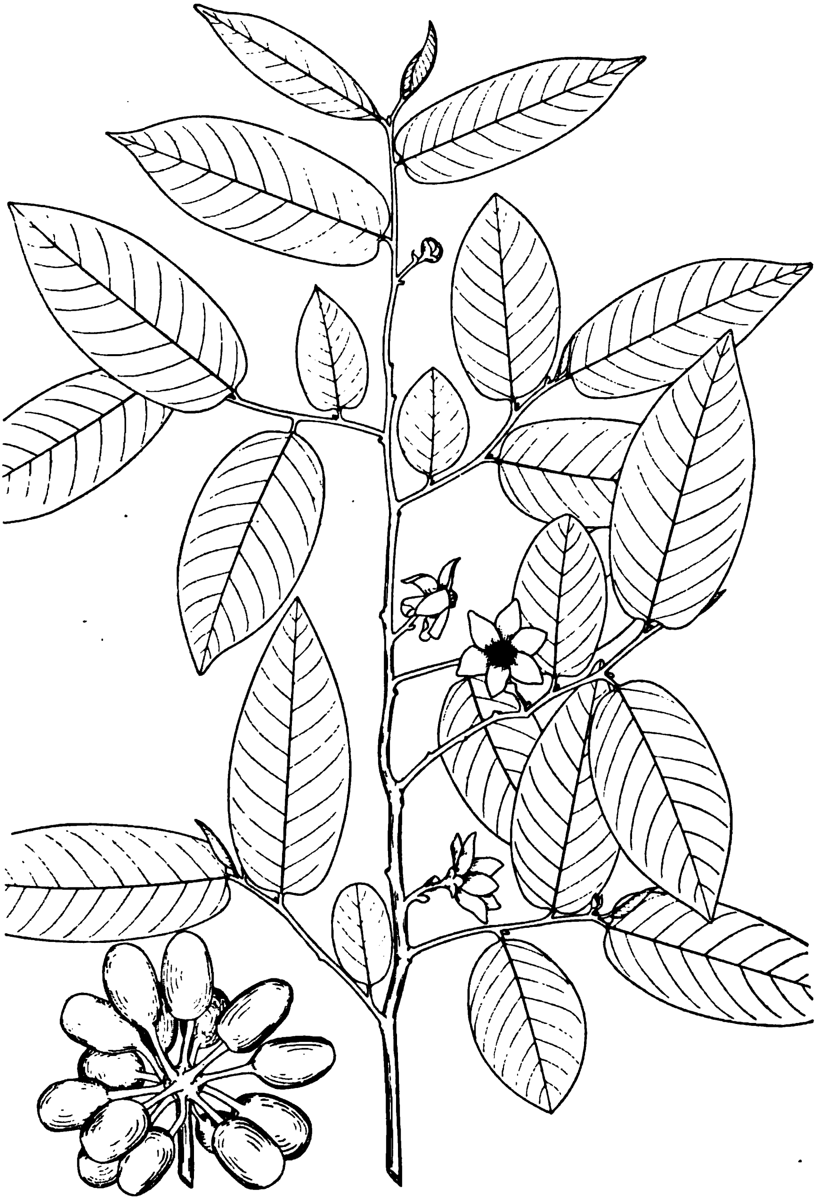

FIGURE 26. UVARIA RUFA (SUSUNG-KALABAU). ×[illegible].

UVARIA SORSOGONENSIS Presl.

Local names: *Alla-allágat, mamogen* (Cagayan); *balongságing* (Palawan); *baluganos* (Negros); *bulágak* (Camarines); *butóan-pulá* (Surigao); *hilalágat-ságing* (Rizal); *hinalágak-ságing* (Laguna, Rizal, Zambales); *malakakáo* (Zambales); *súsung-kalabáu* (Bataan, Palawan).

The fruits are aromatic and edible. They are oval, about 1.5 centimeters in length, and marked with prominent, transverse grooves.

Uvaria sorsogonensis is a large, woody vine with large leaves The flowers are yellow, and about 3 centimeters in diameter. The fruits are borne in rounded clusters.

This species is common and widely distributed from northern Luzon to Basilan, but is not cultivated.

Family LAURACEAE

Genus CINNAMOMUM

CINNAMOMUM INERS Reinw. CINNAMON.

A description and figure of this species and its local names are given in the bulletin on resins, gums and oils.

The bark of this tree is used locally as a substitute for cinnamon, to which it is inferior.

CINNAMOMUM MINDANAENSE Elm. MINDANAO CINNAMON.

A description and figure of this species and its local names are given in the bulletin on resins, gums, and oils.

The bark is sold in commerce as cinnamon, and is the best cinnamon bark produced in the Philippines by a wild species.

Family CAPPARIDACEAE

Genus CAPPARIS

CAPPARIS HORRIDA L. HALUBÁGAT-BÁGING.

Local names: *Baralauik* (Cagayan); *dáuag* (Bataan, Rizal); *habágat-báging, halubágat-báging* (Rizal); *tarabtáb, tarabtáb-uák* (Union).

The fruits are rounded, about 3 centimeters in diameter, with an edible pulp which has a poor flavor.

Capparis horrida is a thorny, woody vine. The leaves are alternate, hairy, pointed at the tip, rounded or somewhat pointed at the base, and from 6 to 12 centimeters in length. The flowers are fairly large, and white turning to pink.

This species has been reported only from Luzon and neighboring islands, and Zamboanga.

CAPPARIS MICRACANTHA DC. HALUBÁGAT-KÁHOI.

Local names: *Balituk* (Bukidnon); *bayábas-uák* (Bataan); *dáuag, halubágat-káhoi* (Rizal); *halubágat* (Nueva Ecija); *kasuit* (Pampanga); *ma-*

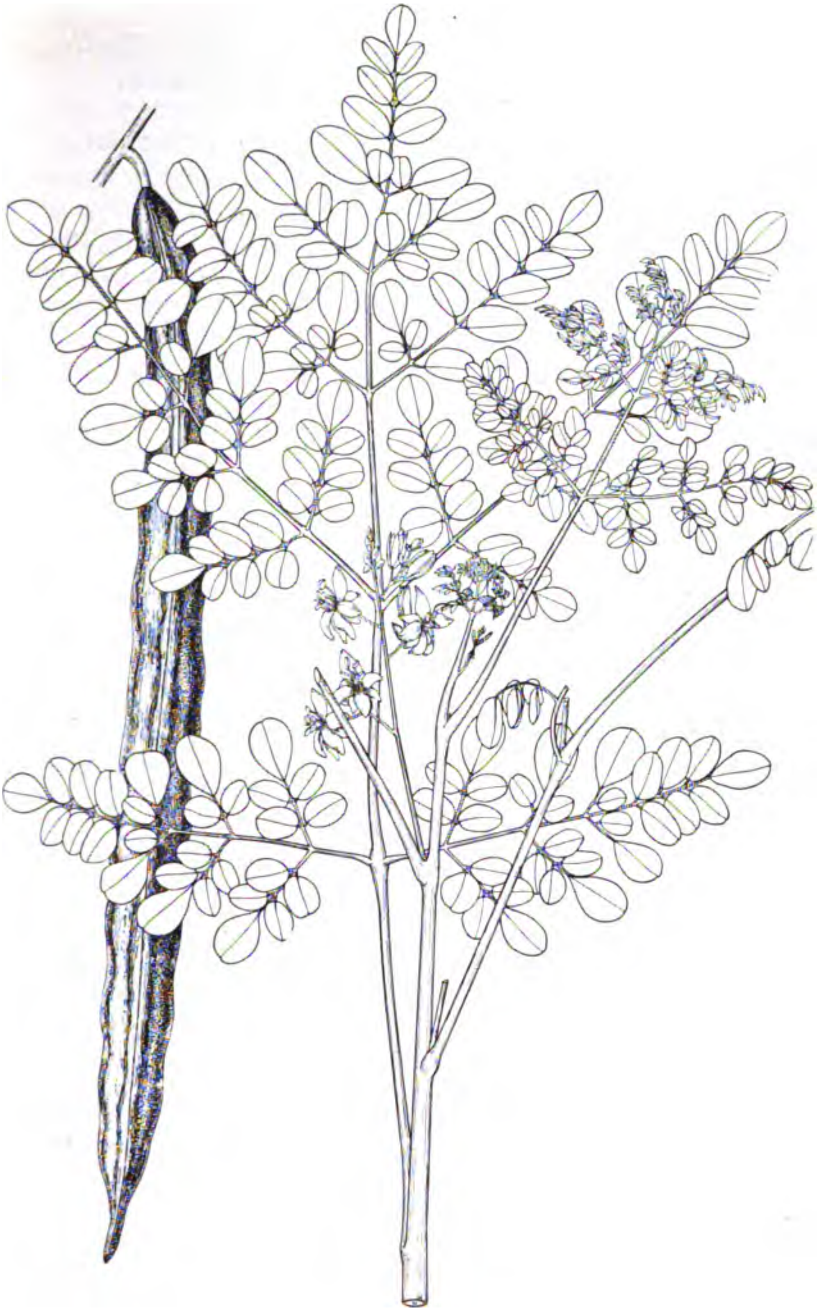

FIGURE 27. MORINGA OLEIFERA (MALUNGGAI). ×½.

ladáyap (Tayabas); *salua-suá* (Laguna); *tarabtáb* (Pangasinan), Ilocos Sur, Union); *tarabtáb-uak, taraptáp* (Union); *tiníkan* (Bataan).

The pulp of the fruit of this species is edible. The fruit is ovoid or globose, and about 5 centimeters in diameter.

Capparis micracantha is a vine or a half-erect shrub with drooping branches. It is 2 to 4 meters high, with short, sharp, nearly straight spines at the bases of the petioles. The leaves are alternate, somewhat elliptical in shape, leathery, shiny; the apex rounded, slightly pointed or notched; the base usually rounded. The flowers occur on the stem above the axils of the leaves. The petals are about a centimeter long, and white, the lower ones yellowish or reddish.

This species is common and widely distributed from northern Luzon to southern Mindanao.

Family MORINGACEAE

Genus MORINGA

MORINGA OLEIFERA Lam. (Fig. 27). MALUNGGÁI.

A description of this species and its local names are given in the bulletin on resins, gums, and oils.

The root of this species has a taste like that of horse-radish and is eaten in India by Europeans as a substitute for horse-radish. The wood has a similar taste.

The leaves and flowers of this tree are cooked and eaten as a vegetable. According to Heyne,* the half-ripe fruits are also used as a vegetable.

Family ROSACEAE

Genus RUBUS

The species of this genus which are found in the Philippines are characterized by the English name raspberry. The fruits of some of them are of very good flavor, while others are insipid.

RUBUS COPELANDII Merr.

The berries are nearly 2 centimeters in diameter, orange red, fairly juicy, and edible, but not well flavored.

Rubus copelandii is a scrambling shrub which may exceed 3 meters in height, but is usually smaller. The leaves and stems are armed with very numerous, medium-sized spines. The leaves are either simple or compound with 2 to 3 leaflets, which have toothed margins and are pointed at the tip and rounded at the base. The flowers are white and occur singly or in clusters.

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 2, page 187.

This species has been reported only from Benguet. It is not cultivated.

RUBUS ELLIPTICUS Sm. TITAU.

The berries are pale yellow, fleshy, and of fairly good flavor.

Rubus ellipticus is a scrambling shrub reaching a height of 3 meters. The stems and petioles are densely covered with long, stiff hairs and armed with rather large spines. The leaves are usually compound with three leaflets which are somewhat rounded or elliptical and frequently flattened at the apex. The lower surfaces are velvety. The flowers are white, and borne in large clusters.

This species is reported only from Bontoc and Benguet. It is not cultivated.

RUBUS ELMERI Focke. BUNUT.

The berry is up to 1.5 centimeters in breadth, orange yellow, and well flavored.

Rubus elmeri is a scrambling shrub reaching a height of about 2 meters. This species is armed with a few small spines. The young stems, flower buds, petioles, and lower surfaces of the leaves are velvety. The leaves have toothed margins, are heart-shaped, and vary from being entire to three- to five-lobed. The flowers are white and are either solitary or borne in clusters.

This species is reported only from the Mountain Province of Luzon, where it is common but not cultivated.

RUBUS FRAXINIFOLIUS Poir. PALANAU.

Local names: *Barini* (Apayao); *lagukanata* (Lanao); *luting, palanau, balaungan* (Benguet); *pinit* (Bontoc); *pupugan* (Lepanto); *sampinit* (Surigao); *sapinit* (Tayabas, Bukidnon); *tugas-tugas* (Negros).

The berries are borne in clusters; they are 10 to 15 millimeters in diameter, bright red, fairly juicy, edible, but rather tasteless.

Rubus fraxinifolius is a scrambling shrub reaching a height of from 2 to 4 meters. The stems and leaves are armed with fair-sized, sharp spines. The leaves are pinnate, with three to eleven leaflets, which have toothed margins, are sharply pointed at the tip, and usually somewhat oblique at the base. The flowers are white, and about 2 centimeters in diameter.

This species is very common in the mountains from Luzon to Mindanao. It is not in cultivation.

RUBUS MOLUCCANUS L. KINUBOT.

The berries are about a centimeter in diameter, red, and edible, but with an insipid flavor.

Rubus moluccanus is a scrambling shrub reaching a height of 2 to 3 meters. The stems and leaves are armed with medium-sized spines. The stems, buds, petioles, and the lower surfaces of the leaves are velvety. The upper surfaces of the leaves are somewhat hairy. The leaves are rather large, and usually somewhat three- to five-lobed. The flowers are about 2 centimeters in diameter, white, and usually borne in clusters.

This species is found in the mountains, from Bontoc to the southern limits of the Archipelago. It is not cultivated.

RUBUS NIVEUS Thumb. PILAI.

The fruits occur in terminal clusters, are about a centimeter in diameter, and have a good flavor.

Rubus niveus is a very spiny, scrambling shrub which may reach a height of 3 meters, but is usually less than a meter in height. The leaves are compound with five to nine leaflets which are usually less than 3 centimeters in length. The margins of the leaflets are prominently toothed; the lower surfaces have a whitish appearance.

This species is reported only from Bontoc and Benguet. It is not cultivated.

RUBUS PECTINELLUS Max. (Fig. 28). ATIBULNÁK.

The fruits are 1.5 centimeters in diameter, bright red, juicy, subacid, and of good quality and flavor. This is considered to be one of the choicest species of the genus in the Philippines.

Rubus pectinellus is a trailing plant with heart-shaped leaves. The stems, leaves, and calyx are armed with small spines. The leaves are very rough, hairy, heart-shaped, have toothed margins, and are usually from 3 to 6 centimeters in diameter. The flowers are white, and upwards of 2 centimeters in diameter.

This species has been reported only from Abra, Lepanto, Bontoc, Benguet, Laguna, Tayabas and Davao. It is not cultivated.

RUBUS ROLFEI Vid.

The berries are yellowish, fleshy, and well flavored.

Rubus rolfei is a scrambling shrub 2 to 3 meters in height. The stems and lower surfaces of the leaves are covered with fine, soft hairs, while the stem and the larger veins of the leaves are armed with small spines. The leaves are very rough, three- to five-lobed, up to 12 centimeters in length, dark green above, brownish beneath, and have toothed margins. The flowers are white, about 3 centimeters in diameter, and are usually borne in groups.

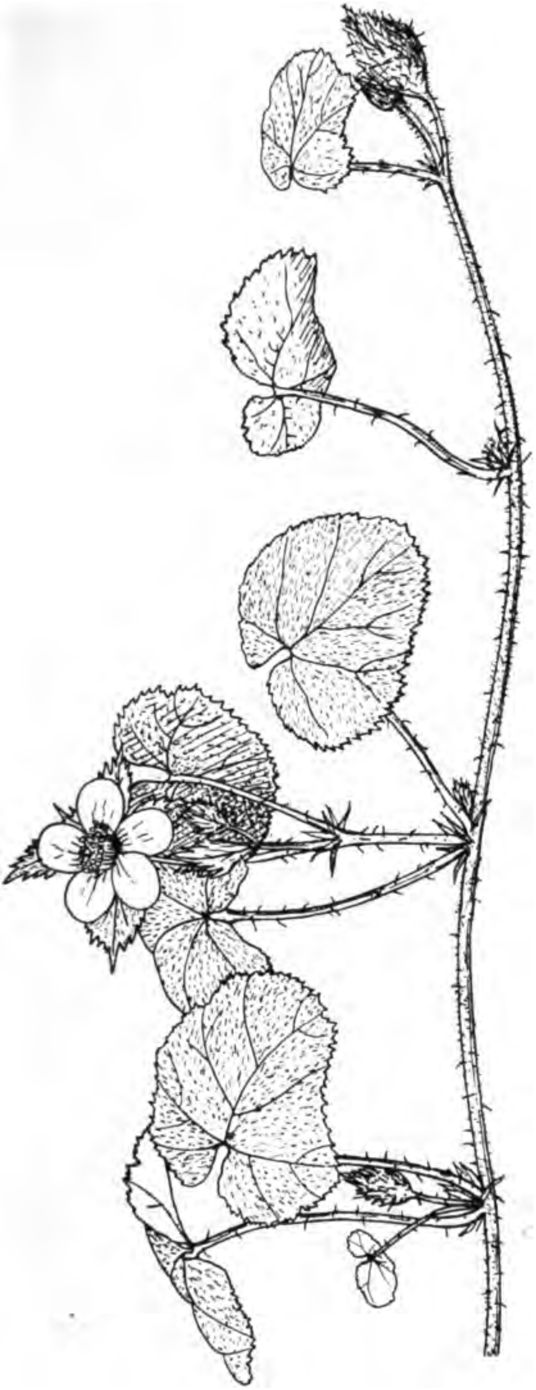

FIGURE 28. RUBUS PECTINELLUS (ATIBULNAK). NATURAL SIZE.

This species is very common in the mountains of Benguet, Laguna, and Negros Occidental. It is not cultivated.

RUBUS ROSAEFOLIUS Sm. INÍT.

Local names: *Init* (Bontoc); *lagiauat* (Bukidnon); *ragíni* (Albay); *sapinít* (Laguna).

The fruits are red, about 1.5 centimeters in diameter, and occur singly or in clusters. They are juicy, but rather insipid.

According to Heyne * the leaves are somewhat astringent, and are eaten both raw and cooked.

Rubus rosaefolius is a spiny shrub rarely exceeding a meter in height. The leaves are pinnate with three to seven leaflets. The leaflets are smooth or hairy, have lobed margins, and are from 2 to 7 centimeters in length. The flowers are white.

This plant is common in the mountains of Luzon, the Bisaya Islands, and Mindanao. It is not cultivated.

Family LEGUMINOSAE

Genus ALBIZZIA

ALBIZZIA LEBBEKOIDES (DC.) Benth. (Fig. 29). KARISKÍS.

Local names: *Kariskís* (Pangasinan, Ilocos Norte, Union, Abra, Zambales, Nueva Ecija); *maganhóp sa búkid* (Sibuyan); *malagánit* (Nueva Ecija, Rizal); *malaghánip* (Rizal); *malaghánit* (Laguna); *malasampálok* (Bataan).

The bark is frequently used in the manufacture of a fermented drink known as basi. For a discussion of this use, see *Macaranga tanarius.*

Albizzia lebbekoides is a tree reaching a height of about 12 meters and a diameter of about 30 centimeters. The leaves are twice pinnate, with narrow leaflets which are about a centimeter in length. The flowers are small, greenish yellow, and occur in rounded clusters on compound inflorescences. The fruit is a thin pod, about 12 centimeters long and 2 centimeters wide.

This species is very common and distributed from northern Luzon to southern Mindanao.

Genus BAUHINIA

BAUHINIA MALABARICA Roxb. (Fig. 30). ALIBANGBÁNG.

Local names: *Albangbáng* (Tarlac); *alibáng* (Rizal); *alibangbáng* (Nueva Ecija, Pampanga, Rizal, Cavite, Laguna); *kalibambáng* (Pampanga, Laguna).

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 2, page 199.

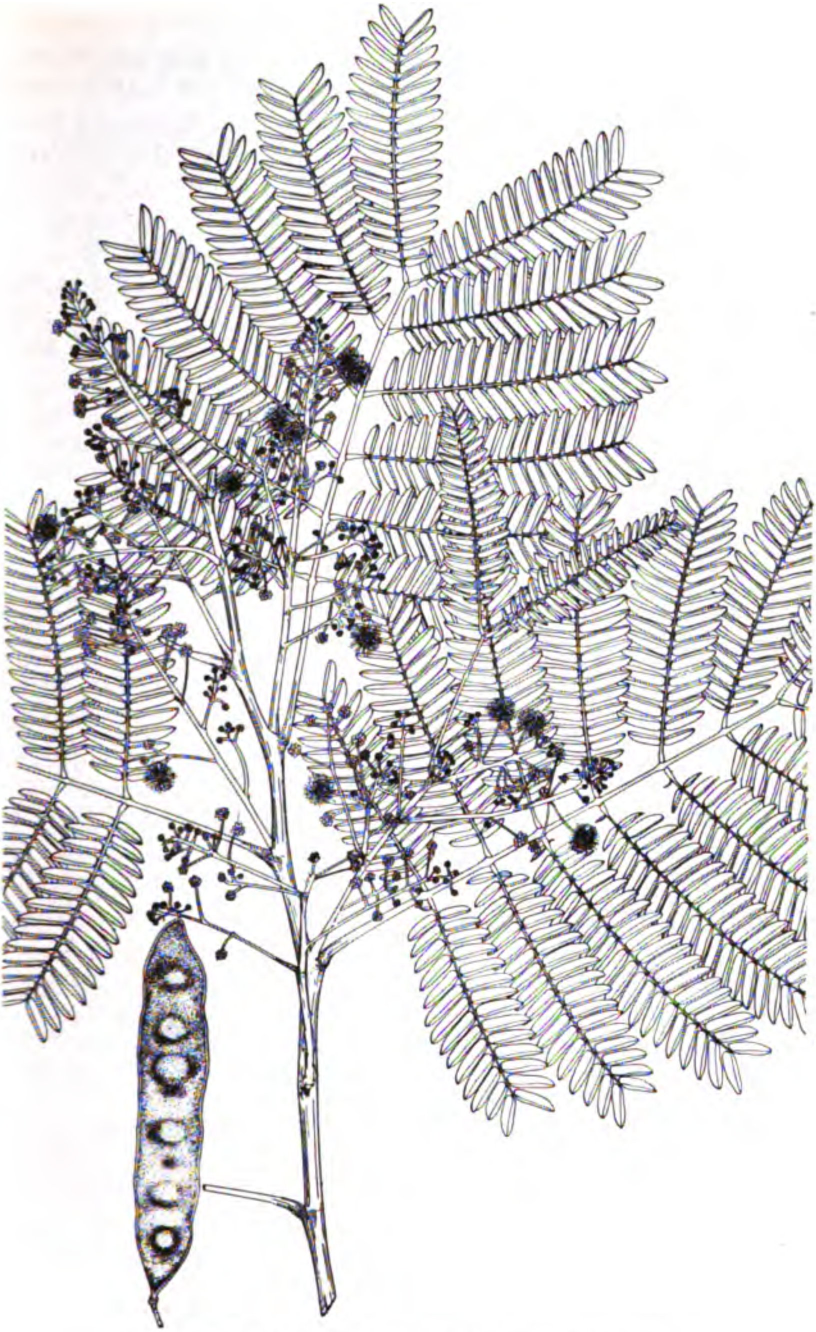

FIGURE 29. ALBIZZIA LEBBEKOIDES (KARISKIS). ×½.

The leaves of this species are sour, and are used considerably by the Filipinos for flavoring meats and fish.

Bauhinia malabarica is a small tree reaching a height of about 8 to 10 meters. The leaves are alternate, heart-shaped at the base, deeply notched at the apex, 5 to 10 centimeters long, and usually wider than long. The flowers are white and rather large. The pods are long, narrow, and flattened.

This species is common in open places and second-growth forests in the Philippines, and is particularly abundant in the early stages of the invasion of grassland by second-growth forests.

Genus LEUCAENA

LEUCAENA GLAUCA (L.) Benth. (Fig. 31). IPIL-ÍPIL.

Local names: *Aghó* (Iloilo); *ciprés* (S. Tayabas); *dátiles* or *biátiles* (Cebu); *ípil* (Rizal, Manila, Cavite, Nueva Ecija, Pampanga, Pangasinan); *ipil-ípil* (Laguna); *Jerusalém* (Batangas); *kabahéro* or *kabaero* (Cebu); *kariskis* (Ilocos Sur); *komkompítis* (Ilocos Sur, Pangasinan); *loíloi* (Leyte); *malagánit* (Nueva Ecija); *palomaria* (Camarines); *San Pedro* (Capiz); *Santa Elena* (Pangasinan, Launa, Rizal, Batangas, Tayabas).

In some provinces the seeds of this species are roasted and ground, and then used as a substitute for coffee. These seeds have been analyzed by Brill.*

The Bureau of Forestry has found ipil-ipil to be a very valuable firewood crop, and also exceedingly useful in reforestation work. It has been planted with great success in grass areas as a nurse crop for forest trees.†

Leucaena glauca is a shrub or small tree 2 to 6 meters high. The leaves are 15 to 25 centimeters long and compound with numerous leaflets which are narrow and 7 to 12 millimeters in length. The flowers are white, and occur in dense, solitary, rounded heads which are 2 to 5 centimeters in diameter. The pods are thin, flat, 12 to 18 centimeters long, 1.4 to 2 centimeters wide, and contain from 15 to 25 elliptical, shiny, brown seeds.

This species is a native of tropical America, but is now found throughout the tropics. It is thoroughly naturalized in the Philippines and very common and widely distributed.

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* Brill, H. C., Ipil, a coffee substitute: Leucaena glauca (Linnaeus) Bentham. Philippine Journal of Science, Volume 11 (1916), pages 101 to 104.

† Matthews, D. M., Ipil-ipil—A firewood and reforestation crop. Bureau of Forestry Bulletin No. 13 (1914).

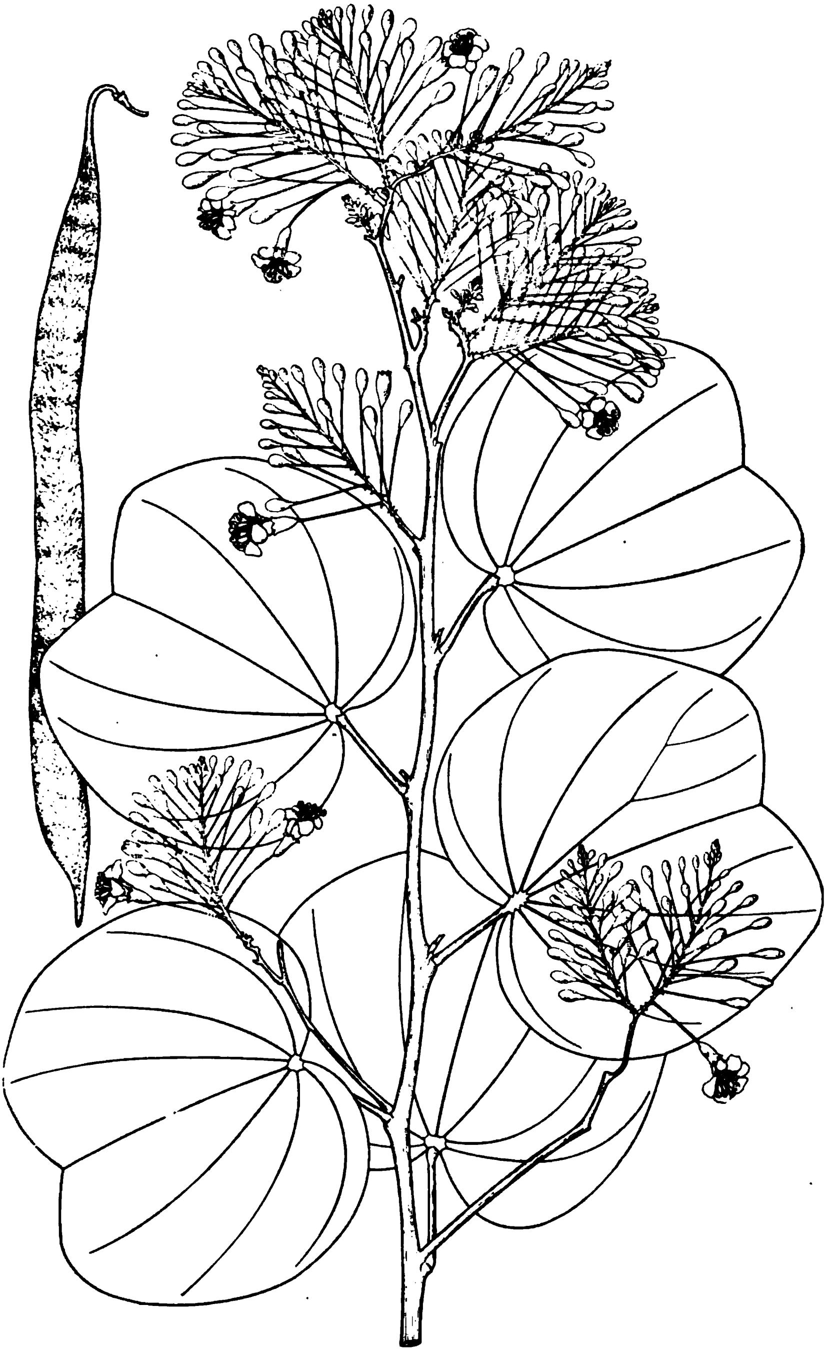

FIGURE 30. BAUHINIA MALABARICA (ALIBANGBANG). X½.

Genus PACHYRRHIZUS

PACHYRRHIZUS EROSUS (L.) Urb. SINGKAMÁS.

A description of this species and its local names are given in the bulletin on resins, gums, and oils.

The roots are large, fleshy, and turnip-shaped. They are eaten either raw or prepared in a variety of ways. The fruit is sometimes used as a vegetable.

Genus PHASEOLUS

PHASEOLUS LUNATUS L. LIMA BEAN OR PATÁNI.

Local names: *Bulai patáni* (Manila vicinity); *katakut* (Bontoc); *parda* (Ilocos Norte); *patáni* (Ilocos Norte, Bontoc, Pampanga, Rizal, Batangas, Camarines).

A form of the ordinary patani or lima bean with dark-colored seeds is common in thickets in some parts of the Philippines. The seeds are sometimes edible, but may be poisonous, deaths having occured from eating them.

Phaseolus lunatus is a slender, smooth, annual, herbaceous vine reaching a length of 4 meters or more. The leaves are somewhat rounded at the base and pointed at the tip. The flowers are greenish or pale yellow, and borne on long stalks. The pods are oblong, somewhat curved, 6 to 12 centimeters long, about 2 centimeters wide, and contain 1 to 4 large seeds.

Genus PITHECOLOBIUM

PITHECOLOBIUM DULCE (Roxb.) Benth. (Fig. 32). KAMACHÍLE.

Local names: *Damortís* (Bontoc, Union, Pangasinan); *kamachíle* (Manila, Camarines); *kamanchile* (Nueva Ecija, Bataan, Manila, Tayabas); *komontres* (Abra).

The pods are often twisted spirally, red when ripe, 10 to 18 centimeters long, and about a centimeter wide. They contain six to eight seeds surrounded by whitish, sweet, edible pulp of good flavor.

Large quantities of the bark of this species are gathered for tanning purposes.

Pithecolobium dulce is a tree 5 to 8 meters in height. The branches are armed with short, sharp spines found at the bases of the leaves. The leaves are twice compound with four leaflets, which are 1 to 4 centimeters in length. The flowers are white, and in dense heads which are about a centimeter in diameter.

This species is a native of tropical America, but is now thor-

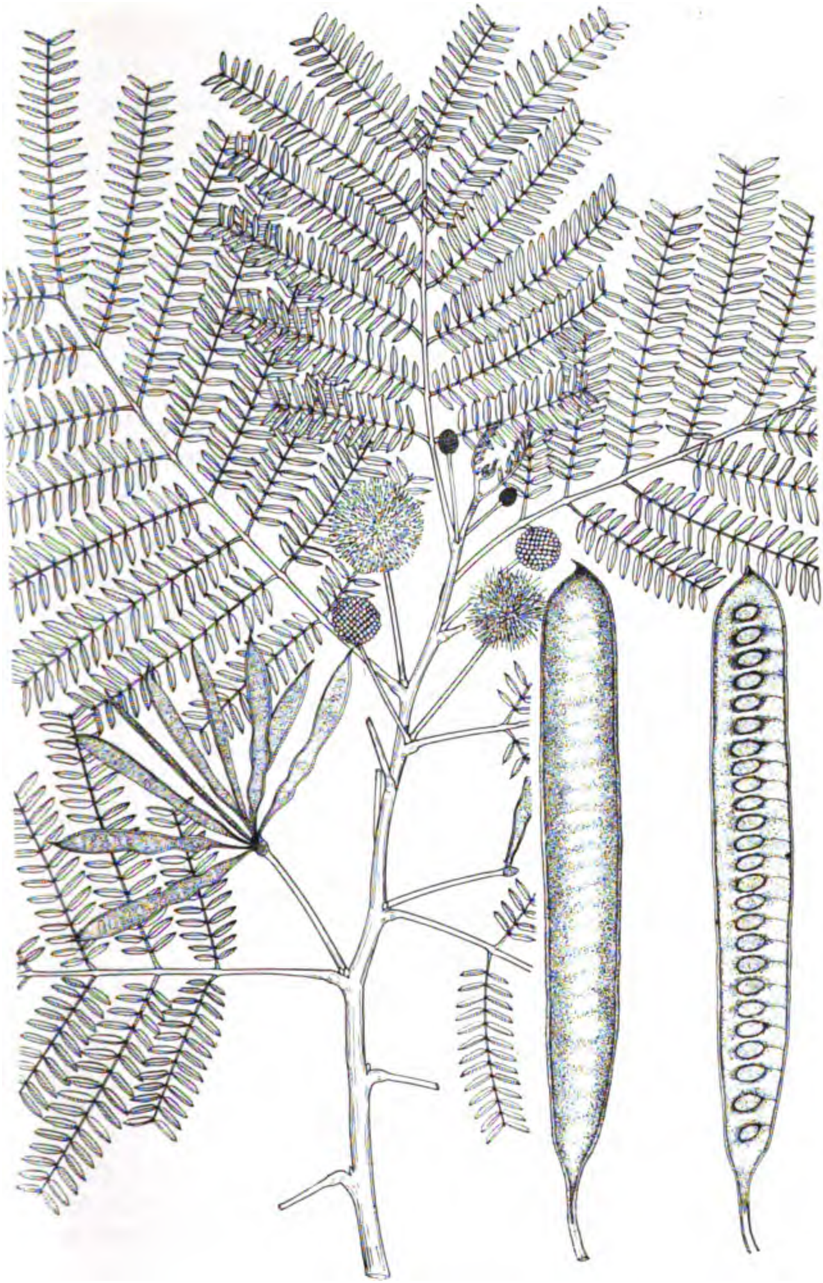

FIGURE 31. LEUCAENA GLAUCA (IPIL-IPIL). ×⅓.

oughly naturalized in the Philippines. It is common and widely distributed.

Genus SESBANIA

SESBANIA GRANDIFLORA Benth. KATÚRAI.

A description of this species and its local names are given in the bulletin on resins, gums, and oils.

The flowers are cooked as a vegetable. The young fruits are eaten in the same manner as are string beans.

Genus TAMARINDUS

TAMARINDUS INDICA L. (Fig. 33). SAMPÁLOK.

Local names: *Salomági* (Cagayan, Ilocos Norte); *sambág, sanbág* (Iloilo, Guimaras Island); *salumági* (Abra); *sampálok* (Union, Pangasinan, Tarlac, Pampanga, Zambales, Bulacan, Manila, Rizal, Laguna, Tayabas, Camarines).

The pods are 6 to 15 centimeters long, 2 to 3 centimeters wide, and constricted between the seeds, which are surrounded by an acid pulp of good flavor. The young leaves are boiled as a flavoring with meat.

Tamarindus indica is a large tree from 12 to 25 meters in height. The leaves are 6 to 10 centimeters long, unevenly pinnate with 20 to 40 leaflets which are 1 to 2 centimeters long. The petals are yellowish with pink stripes, and less than a centimeter in length.

This species is probably a native of tropical Africa, but is now cultivated in all tropical countries. It is grown extensively in the Philippines for its fruit and as a shade tree, but also occurs spontaneously. It is apparently more abundant in Luzon than in the Bisaya Islands or Mindanao.

Family OXALIDACEAE

Genus AVERRHOA

AVERRHOA BILIMBI L. (Fig. 34). KAMIÁS.

Local names: *Iba* (Camarines, Mindoro, Masbate, Iloilo, Negros, Davao, Basilan); *kalamiás* (Mindoro); *kolonanas* (Tayabas); *kamiás* (Nueva Ecija, Bataan, Manila, Rizal, Laguna); *puis* (Amburayan subprovince).

The fruit is somewhat cylindrical or with five obscure, broad, rounded, longitudinal lobes. It is about 4 centimeters long, green, acid, and edible.

Averrhoa bilimbi is a small tree 5 to 12 meters high. The leaves are pinnate, and from 20 to 60 centimeters in length. The leaflets are opposite, with 10 to 17 pairs, pointed at the tip, rather narrow, and 5 to 10 centimeters long. The flowering branches grow from the trunk and larger branches. They are hairy and 15 centimeters or less in length. The flowers are

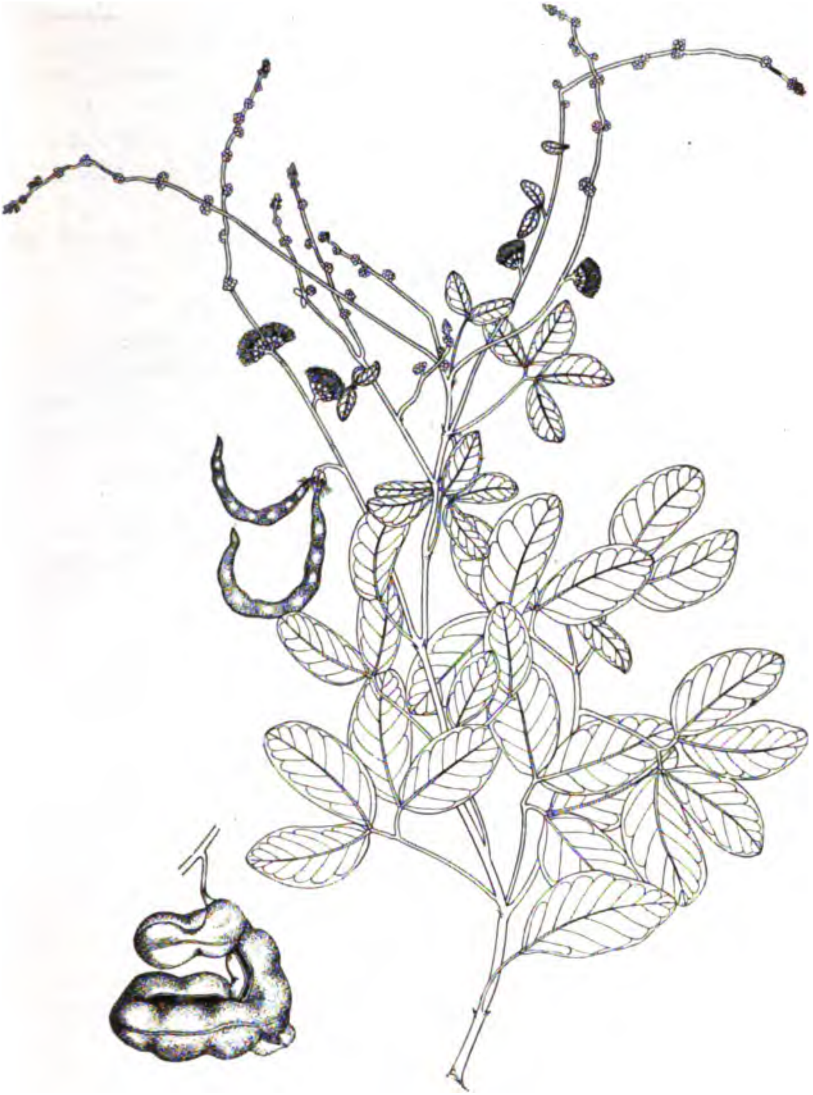

FIGURE 32. PITHECOLOBIUM DULCE (KAMACHILE). ×½.

fragrant and about 1.5 centimeters long. The corolla is purple, often marked with white.

This species is common and widely distributed from northern Luzon to the Sulu Archipelago. It is frequently cultivated.

AVERRHOA CARAMBOLA L. (Fig. 35). BALIMBÍNG.

Local names: *Balimbíng* (Nueva Ecija, Rizal, Tarlac, Manila, Laguna, Pampanga, Bulacan, Bataan, Camarines); *daligan* (Lepanto); *dalihan* (Cagayan); *garulan, galluran* (Cagayan); *sirináte* (Abra).

The fruit is fleshy, acid, green or greenish-yellow, usually about 6 centimeters long, with five (very rarely six), longitudinal, angular lobes, and is edible.

Averrhoa carambola is a shrub or small tree reaching a height of about 6 meters. The leaves are pinnate and about 15 centimeters long. There are usually about 5 pairs of leaflets which are opposite, smooth, pointed at the tip, the upper one about 5 centimeters long and the lower ones smaller. The flowering branches are small, occur in the axils of the leaves, and are usually about 3 centimeters long. The flowers are 5 to 6 millimeters in length, and purple, the petals often having a white margin.

This species is a native of tropical America, but is common and widely distributed in the Philippines. It is usually cultivated.

Genus OXALIS

OXALIS REPENS Thunb.

Local names: *Marasiksík* (Union); *pichik* (Batanes); *susokoyili, taíñgang-dagá* (Tagalog).

This species is eaten as an ingredient of salads.

Oxalis repens is a small, prostrate herb. The stems are creeping, up to 50 centimeters in length, usually root at the nodes, and have long, scattered hairs. The leaves are trifoliate. The petioles are 5 centimeters long, and the leaflets are 0.5 to 1.5 centimeters in length. The flowers are yellow, 1 to 3 on each stalk, and nearly a centimeter in length. The fruit is a hairy, somewhat cylindrical capsule 1 to 1.8 centimeters in length.

This species is widely distributed in the Philippines in waste places.

Family RUTACEAE

Genus CITRUS

CITRUS HYSTRIX DC. KABÚYAU.

A description and figure of this species and its local names are given in the bulletin on resins, gums, and oils.

The fruits are about 8 centimeters in diameter and very sour.

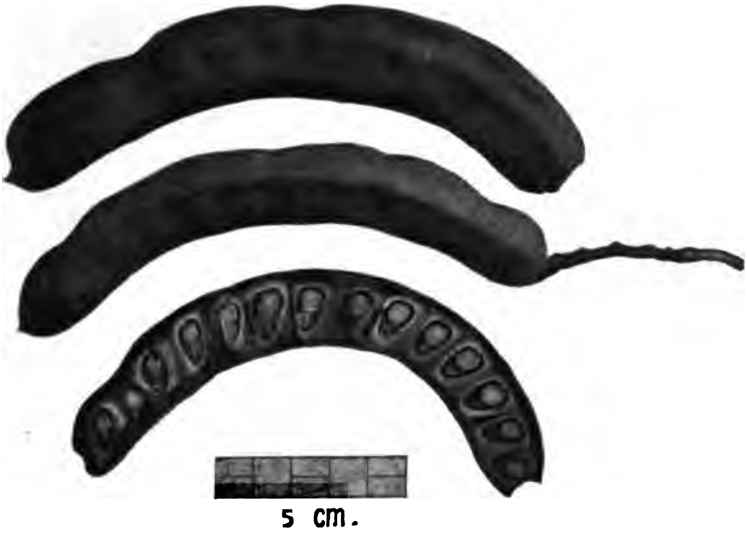

FIGURE 33. TAMARINDUS INDICA (SAMPALÓK).

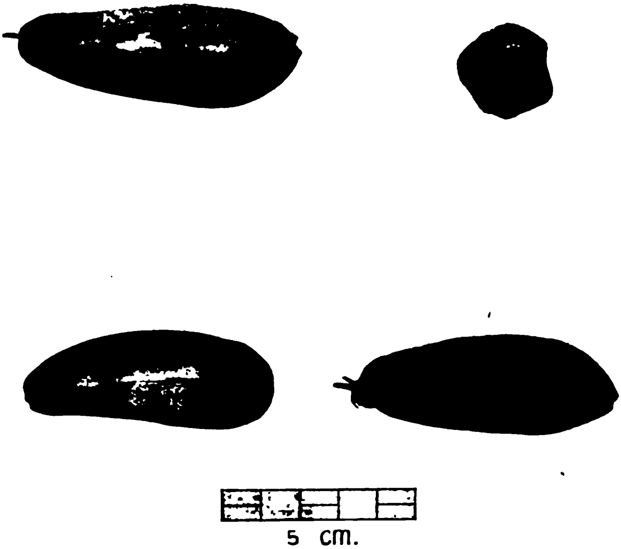

FIGURE 34. AVERRHOA BILIMBI (KAMIAS).

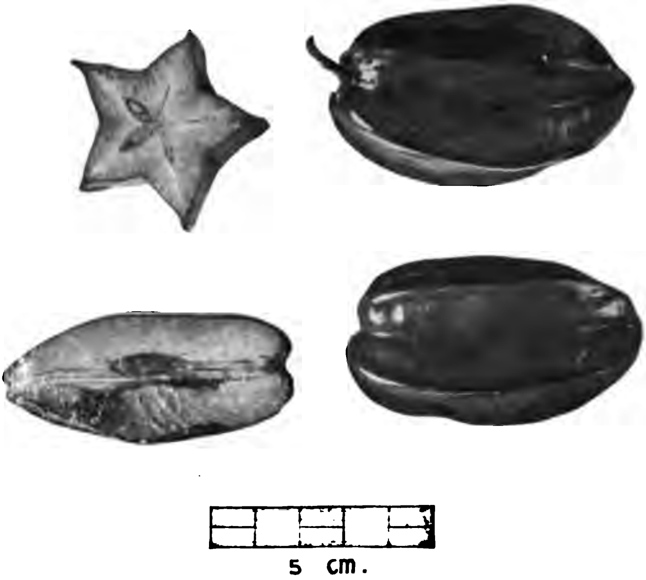

FIGURE 35. AVERRHOA CARAMBOLA (BALIMBING)

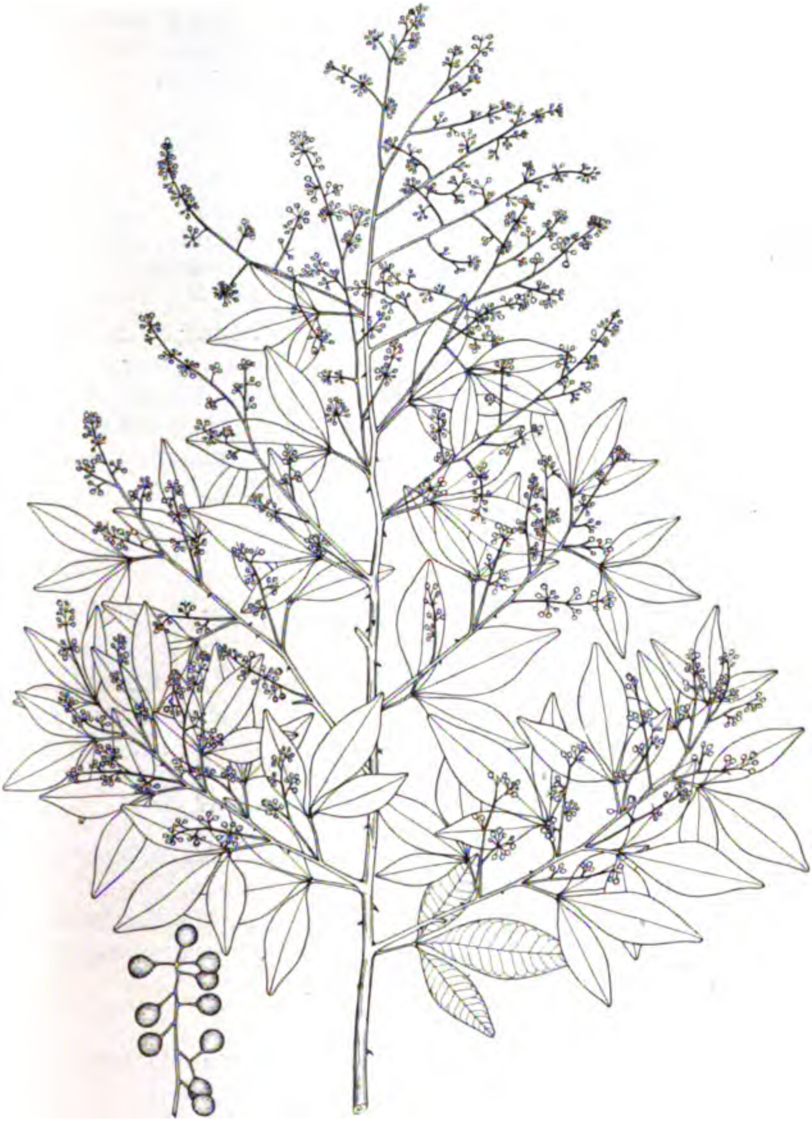

FIGURE 36. TODDALIA ASIATICA. ×½

Genus TODDALIA

TODDALIA ASIATICA (L.) Kurz. (Fig. 36).

A description of this species and its local names are given in the bulletin on resins, gums, and oils.

In the Philippines the fruits are used to flavor many dishes, and also as a tonic for the stomach, and to prevent fevers. According to Heyne * all parts of the plant are used in the manner described above.

Genus TRIPHASIA

TRIPHASIA TRIFOLIATA (Burm.) P. Wils.

Local names: *Dáyap* (Bataan); *kalamansito* (Union); *kamalitos* (Laguna); *limoncíto* † (Cagayan, Zambales, Bataan, Bulacan, Laguna, Camarines, Albay, Iloilo, Antique, Surigao, Lanao, Zamboanga); *limoncítong-kastíla* (Camarines); *sua'-súa'* (Camarines); *tagimunau* (Cagayan).

The fruits are ovoid, fleshy, red, and about 12 millimeters long. They are eaten either raw or cooked as a sweet.

Triphasia trifoliata is a shrub reaching a height of 3 to 7 meters. At the base of each leaf there are two sharp spines. The leaves are alternate with three leaflets which have slightly toothed margins. The flowers are white, fragrant, and about 1 centimeter long.

This species is widely distributed in the settled areas of the Philippines and is sometimes cultivated.

Family BURSERACEAE

Genus CANARIUM

The genus *Canarium* contains several species having edible nuts. The most important of these is *Canarium ovatum*, which has a large nut known as pili.

CANARIUM LUZONICUM (Bl.) A. Gray. PILI.

A description and figure of this species and its local names are given in the bulletin on resins, gums and oils.

This species is more valuable for the resin, Manila elemi, than for its nuts. The nut is similar to that of *Canarium ovatum*, but smaller.

CANARIUM OVATUM Engl. PILI.

A description and figure of this species and its local names are given in the bulletin on resins, gums, and oils.

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 3, page 10.

† This name, a diminutive of Spanish *limón*, belongs rather to the limes (*Citrus mitis* Blanco, and perhaps other species of *Citrus*).

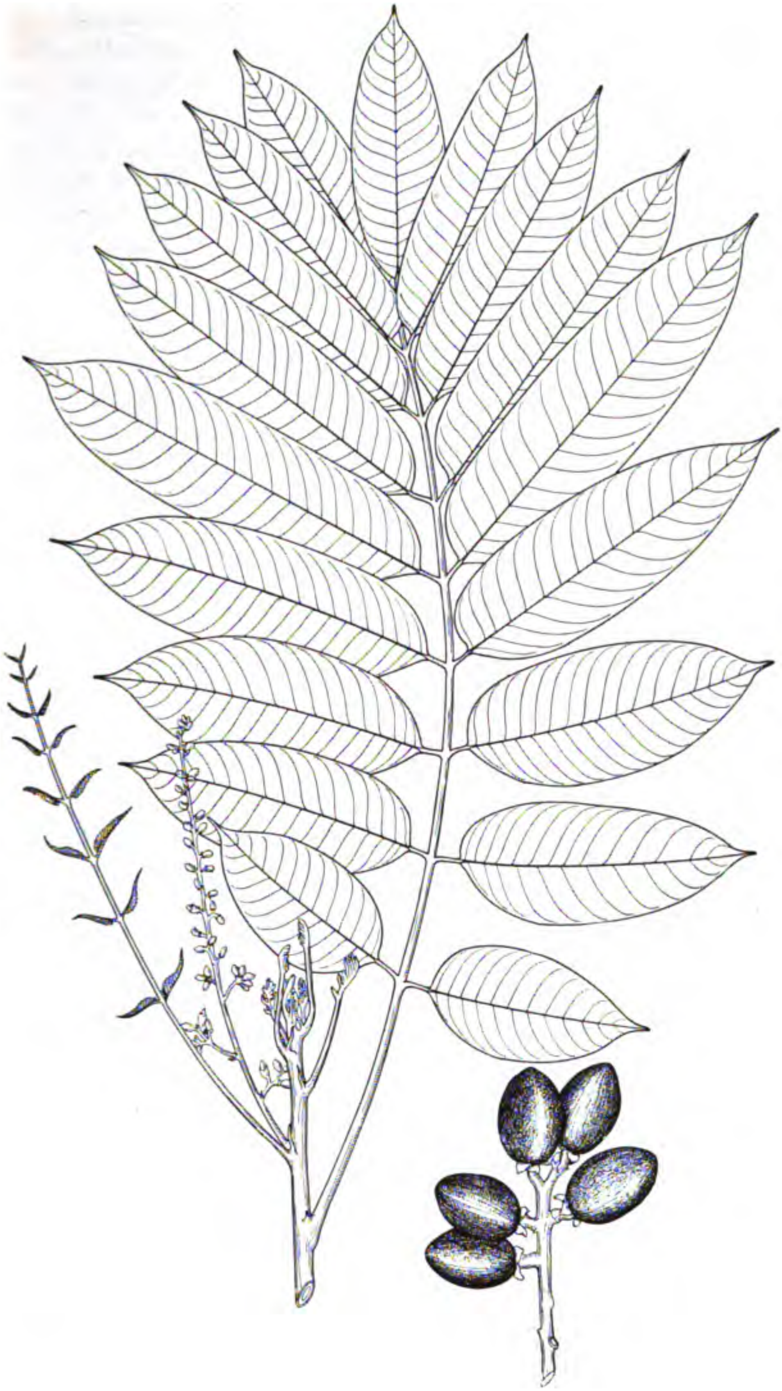

FIGURE 37. CANARIUM WILLIAMSII (GISAU). ×⅓.

The nut, after the outer covering is removed, is about 5 centimeters long, very hard, triangular, and pointed at both ends. It contains a large kernel very rich in oil which when roasted has a delicious flavor. This is served in the same manner as the almond, and by many is considered to be superior to the latter. The nuts are also used considerably in the making of confections. Uncooked they have a purgative effect. In 1913, 1,186,173 kilograms of pili nuts were exported from Manila.

CANARIUM WILLIAMSII C. B. Rob. (Fig. 37). GISÁU.

Local name: *Gisau* (Mindanao).

This species produces a nut similar to the pili nut.

Canarium williamsii is a tree reaching a height of about 18 meters and a diameter of 20 centimeters. The leaves are pinnate, with opposite pinnae, and about 80 centimeters in length. The flower, which has three white petals, is about 7 millimeters long.

This species has been reported only from Mindanao and neighboring islands.

Family MELIACEAE

Genus AGLAIA

AGLAIA EVERETTII Merr. (Fig. 38). BULÓG.

Local names: *Bagasantól* (Leyte); *bubúa* (Negros Occidental); *bubúnau* (Bisaya); *bulóg* (Tablas Island); *buñguás, malasantól* (Cebu); *lumbánau* (Surigao).

The fruits are oval, 4 or 5 centimeters in length or longer, red, and contain an edible pulp.

Aglaia everettii is a tree reaching a height of 20 meters and a diameter of 70 centimeters. The leaves are compound with rather large, smooth, usually opposite leaflets. The flowers are small, yellow, and borne on rather large, compound inflorescences.

This species is distributed from northern Luzon to southern Mindanao and is very common in the Visayan Islands. It is not in cultivation.

AGLAIA GLOMERATA Merr. KARAMIRAS.

Local names: *Bulóg* (Negros); *karáiap* (Buikdnon); *karamiras* (Mindoro); *kuling-manók* (Laguna); *kaníuing-putí, bayánti* (Rizal); *saplúñgan, matamatá* (Basilan); *tibúñgau* (Isabela).

The fruits are about 2 centimeters in diameter, red, velvety, fairly juicy, and edible, though lacking in flavor.

Aglaia glomerata is a tree reaching a height of 20 meters and

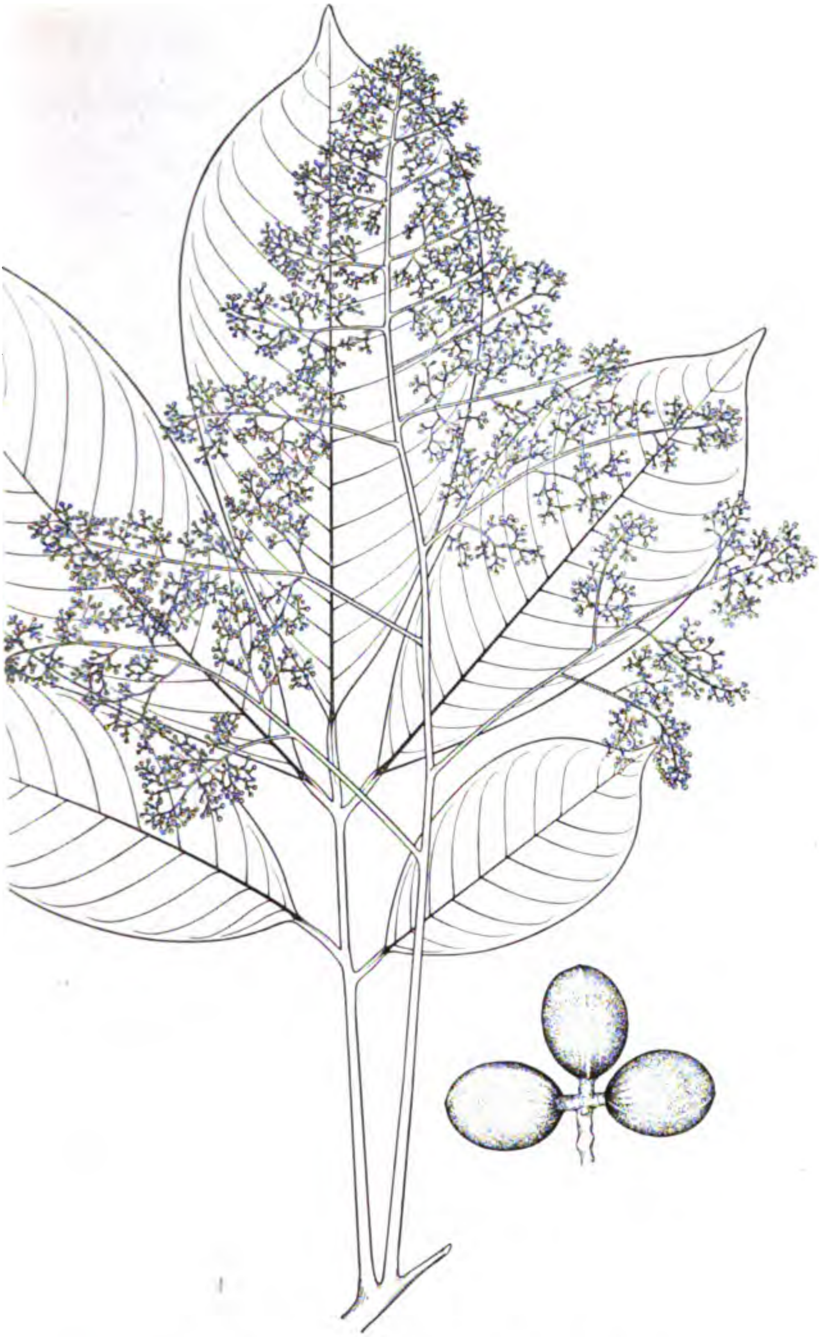

FIGURE 38. AGLAIA EVERETTII (BULOG). ×½.

a diameter of 40 centimeters. The leaves are compound with 5 to 7 leaflets which are hairy. The flowers are small, and borne on compound, axillary inflorescences.

This species is distributed from northern Luzon to southern Mindanao. It is not cultivated.

AGLAIA HARMSIANA Perk. (Fig. 39). MALATUMBÁGA.

Local names: *Balinsiagáu* (Pangasinan); *bayánti* (Laguna, Batangas); *bayóg* (Guimaras Island); *daiamiras* (Mindoro); *hagáson* (Leyte); *kagatóñgan, sulmin* (Rizal); *kamatamatá* (Lanao); *kaníui-putí* (Rizal, Laguna); *malaságing* (Tayabas, Leyte); *malatumbága, matang-uláng* (Bataan); *mamonák, saplúñgan* (Zamboanga); *matamatá* (Sorsogon); *odlíng* (Capiz); *paiatáñgan, sallapugud, batukanág* (Ilocos Sur); *pilipíli* (Camarines); *salamúñgai* (Batangas); *tadiáng-kalabáu* (Laguna); *tañgíling-bañgóhan* (Bulacan); *tibúñgau, palatáñgen* (Cagayan).

The fruits are about 2 to 2.5 centimeters in diameter, rounded, and red to russet colored. They have a hard outer covering, and contain a single seed. The pulp around the seed has a good flavor, somewhat resembling that of the cranberry.

Aglaia harmsiana is a tree reaching a height of about 25 meters and a diameter of about 50 centimeters. The leaves are alternate and compound, usually with five to seven pairs of leaflets. The leaflets are smooth, pointed at both ends, and from 6 to 20 centimeters in length. The flowers are small, yellow, and borne on rather large, compound inflorescences.

This species is common and widely distributed throughout the Philippines. It is not in cultivation.

Genus LANSIUM

LANSIUM DUBIUM Merr. (Fig. 40). MAMATÁ-BABÁE.

Local names: *Bisik* (Zamboanga); *bubahan* (Negros Occidental); *maladáyap* (Tayabas); *mamatá-babáe* (Masbate); *tamaúhan* (Ticao Island); *tul-ánan* (Samar); *uban-úban, malakanasi* (Camarines).

The fruits are about 2.5 centimeters in diameter, rounded, brownish yellow, and edible. They are surrounded by a hard outer covering, and contain a single seed.

Lansium dubium is a tree reaching a height of about 15 meters and a diameter of 25 centimeters. The leaves are opposite, smooth, pointed at both ends, and 6 to 15 centimeters in length. The flowers are small, yellow, and borne on slender spikes.

This species is distributed from central Luzon to southern Mindanao. It is not in cultivation.

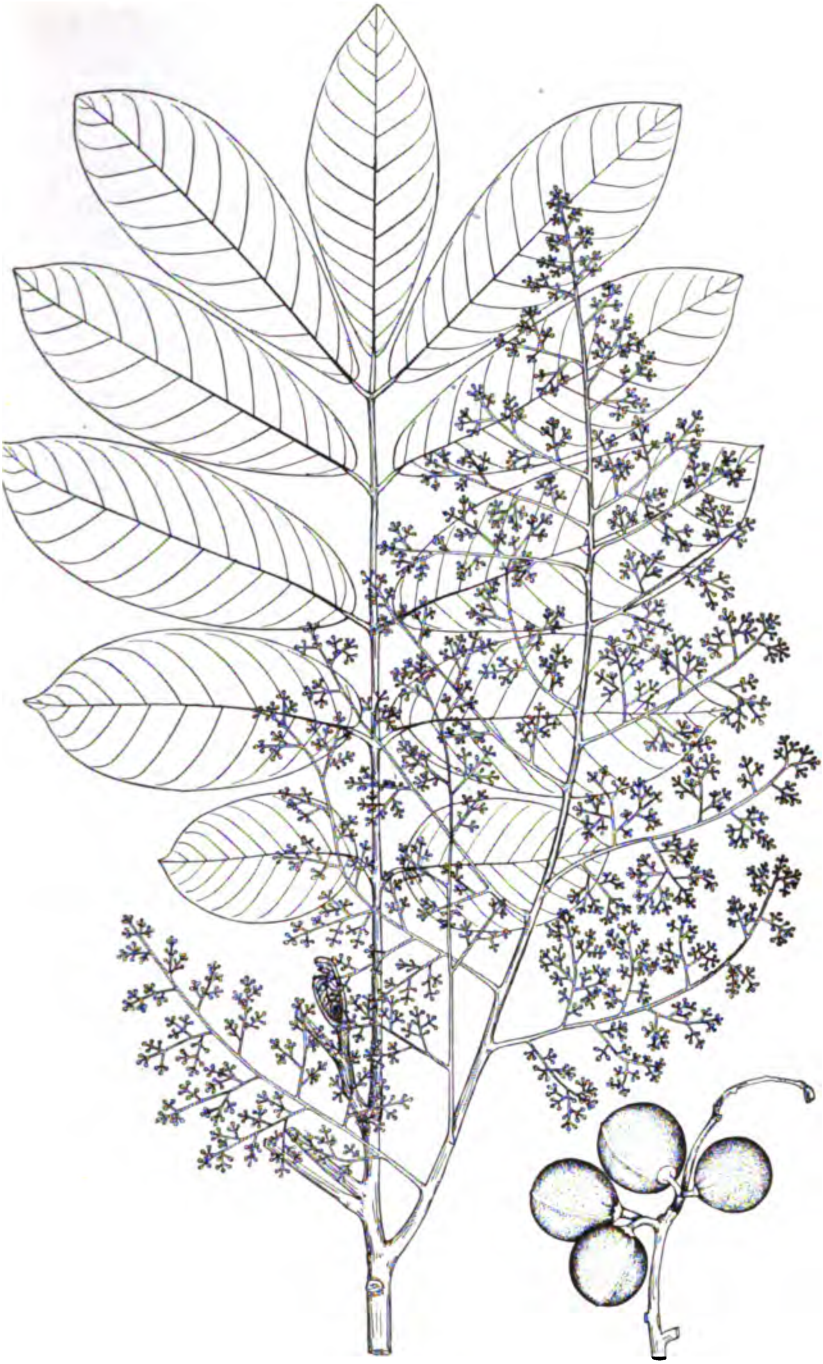

FIGURE 39. AGLAIA HARMSIANA (MALATUMBAGA). ×½.

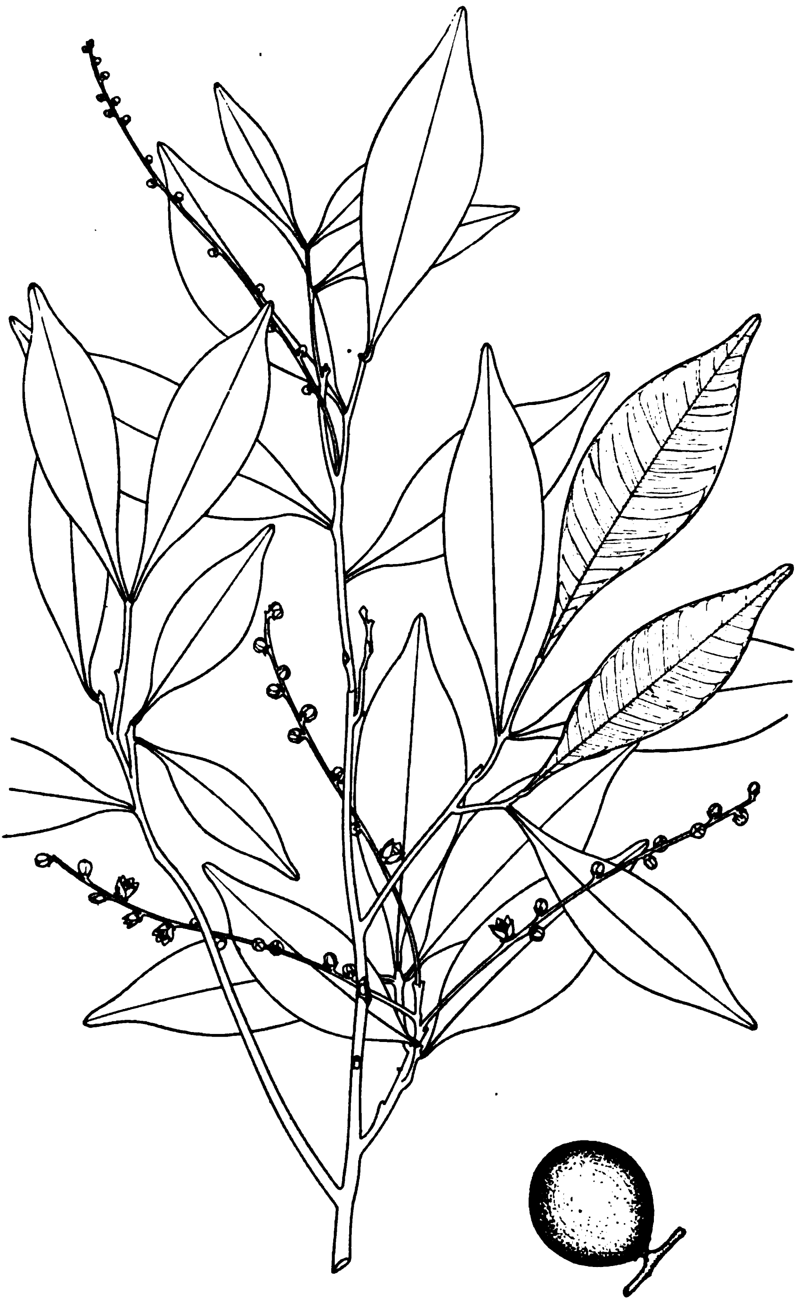

FIGURE 40. LANSIUM DUBIUM (MAMATA-BABAE). ×½.

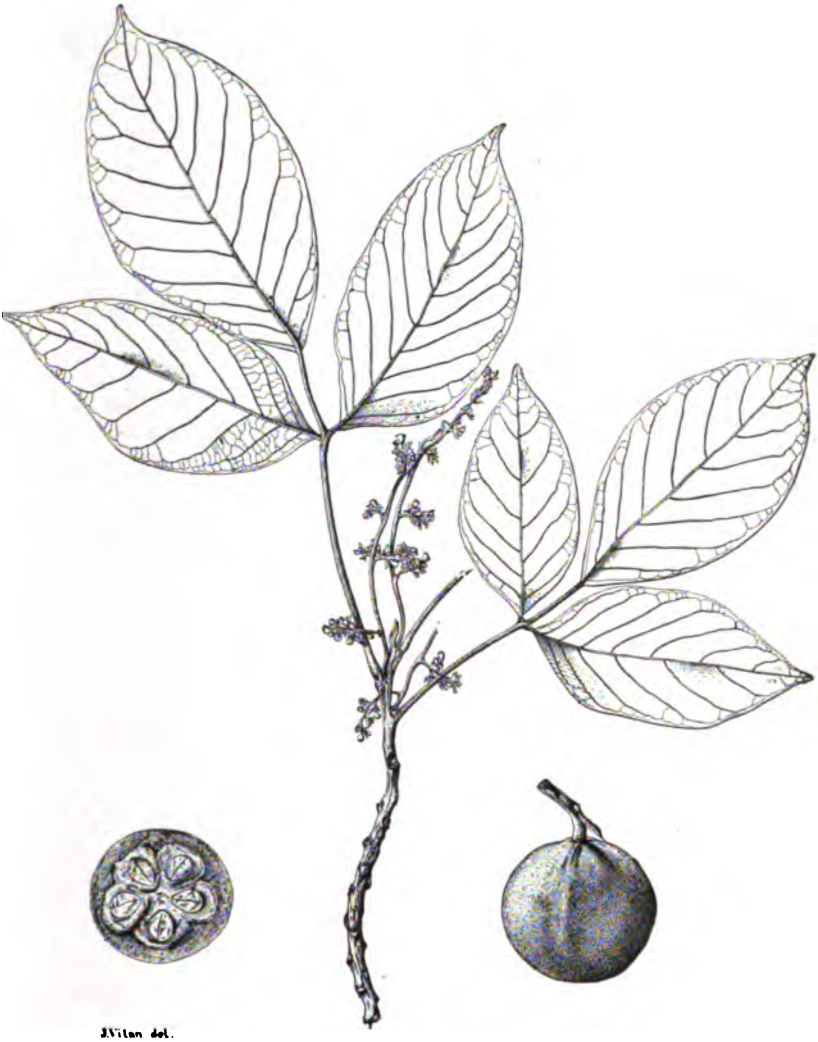

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FIGURE 41. SANDORICUM KOETJAPE (SANTOL).

Genus SANDORICUM

SANDORICUM KOETJAPE Merr. (*S. indicum* Cav.) (Fig. 41). SANTÓL.

Local names: *Santól* (Ilocos Norte and Sur, Abra, Lepanto, Zambales, Tarlac, Pampanga, Nueva Ecija, Bulacan, Bataan, Manila, Tayabas, Camarines, Albay, Sorsogon, Mindoro, Polillo, Leyte, Palawan, Basilan); *santor* (Zamboanga).

The fruit is rounded or somewhat flattened, 4 to 6 centimeters in diameter, and yellowish. The outer covering is very thick. The seeds are large, and surrounded by translucent or pale, acid, edible pulp of good flavor. Peeled, quartered and cooked in syrup, they make a delicious preserve.

Sandoricum koetjape is a tree reaching a height of about 25 meters and a diameter of about 80 centimeters. The leaves are alternate and trifoliate. The leaflets are hairy, somewhat elliptical in shape, pointed at the tip, rounded or slightly pointed at the base, and 10 to 25 centimeters long. The flowers are greenish yellow or straw colored, about 1 centimeter in length, and occur in considerable numbers on compound inflorescences.

This species is distributed from northern Luzon to southern Mindanao and is very common in Luzon. It is both cultivated and wild.

Family EUPHORBIACEAE

Genus ANTIDESMA

ANTIDESMA BUNIUS Spreng. (Figs. 42, 43). BIGNÁI.

Local names: *Bignái* (Zambales, Manila, Rizal, Laguna, Batangas); *bignái-kalabáu* (Manila vicinity); *bugnái* (Ilocos Sur, Abra, Cagayan, Union, Nueva Ecija, Camarines, Mindoro, Iloilo, Cebu); *bugnéi* (Bontoc); *bunnái* (Isabela); *isip* (Pampanga); *pagiruga* (Cagayan).

The fruit is ovoid, red, about 8 millimeters long, fleshy, acid, and edible. It contains a single seed.

Antidesma bunius is a small tree 4 to 10 meters in height. The leaves are small, shiny, somewhat oval in shape, pointed at the tip, rounded or pointed at the base, and 8 to 20 centimeters long. The flowers are small and green. The male flowers are borne on spikes and the female ones on racemes.

This species is common and widely distributed in open places and second-growth forests throughout the Philippines. It is rarely cultivated. It is one of the commonest trees in the first stages of the invasion of grassland by second-growth forests.

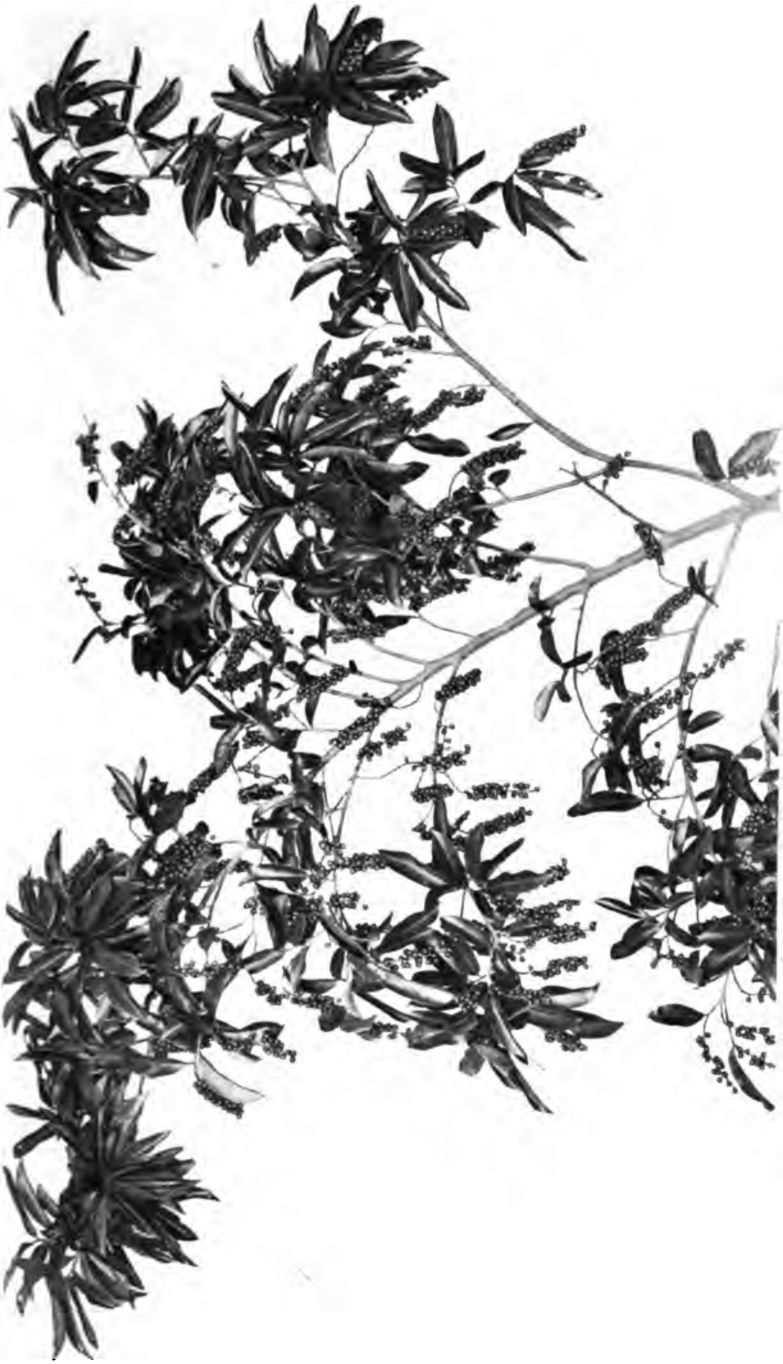

FIGURE 42. ANTIDESMA BUNIUS (BIGNAI).

Genus CICCA

CICCA ACIDA (L.) Merr. (Fig. 44). ÍBA.

Local names: *Iba* (Tayabas, Manila); *karamái* (Ilocos Sur, Abra); *karmái* (Mindoro); *laioán* (Camarines).

The fruit is rounded, greenish-white, 1 to 1.5 centimeters in diameter, fleshy, acid, edible, and contains a hard, bony, 6- to 8-grooved stone.

Cicca acida is a small deciduous tree 4 to 9 meters in height. The branches bear nodules in the axils of the fallen leaves. The leaves are smooth, 20 to 40 centimeters long, pinnate with alternate pinnae, which are rounded at the base, pointed at the tip, and from 2 to 7 centimeters long. The flowers are small, pink, and crowded in clusters on racemes which grow from the nodules on the branches. Male and female flowers are usually on separate plants.

This species is widely distributed in and about towns in the Philippines and is occasionally cultivated for its edible fruits.

Genus MACARANGA

MACARANGA TANARIUS Muell-Arg. (Fig. 45). BINÚÑGA.

Local names: *Alañgabun, anabun* (Bagobo); *bagambáng, ma-ásim* (Rizal); *bilua* (Pampanga); *biluán, binungan, malabúñga, biluan-lalaki* (Bataan); *bilúñga* (Tayabas); *bing-ua* (Nueva Vizcaya); *binúñga* (Bataan, Bulacan, Rizal, Laguna, Camarines, Polillo, Mindoro, Guimaras Island, Negros, Palawan); *binuga, luñgakan* (Davao); *gamú, samuk* (Cagayan); *ginabang* (Benguet); *labauel* (Lepanto); *lagau* (Bisayan); *lagaon, ligabon* (Manobo); *malabúñga* (Mindanao); *mindáng* (Camarines); *minúñga* (Agusan); *samák* (Ilocos Norte, Abra, Camiguin Island).

The bark and leaves of this tree are extensively utilized in the manufacture of a popular fermented drink known as basi. The fruits are sometimes used for the same purpose.

The bark is removed in large sheets and then cut into strips about 1.5 meters in length and about 20 centimeters in width. The strips are dried in the sun, sorted, and packed in bundles of from twenty to fifty pieces. These bundles sell at from 20 to 50 centavos or more.

The dried leaves are gathered after they have fallen from the tree. The petioles and larger veins are removed and the remaining part crushed.

Basi is made from sugar-cane juice to which binuñga bark and leaves, and sometimes other ingredients, are added. There are two quantities of basi: basi-núang (carabao basi), which is harsh to the taste, strong, astringent, and not sweet; and basi-

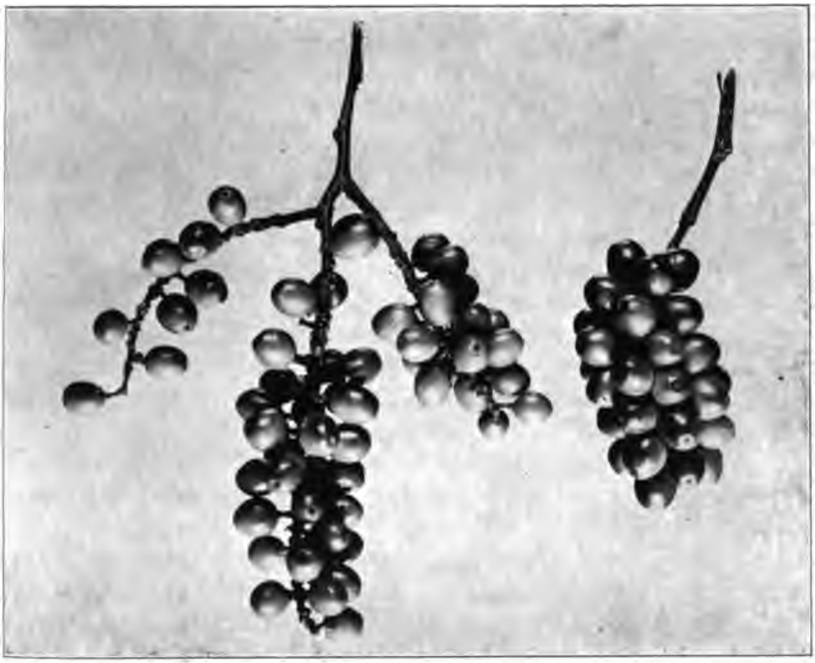

FIGURE 43. ANTIDESMA BUNIUS (BIGNAI).

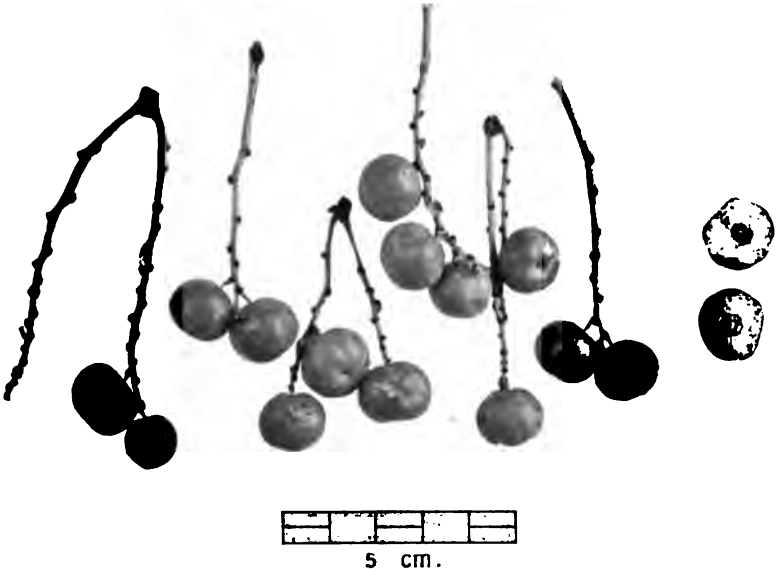

FIGURE 44. CICCA ACIDA (IBA).

babae, which has a soft, sweet taste. The latter is made from the more concentrated syrup.

The process of manufacture is in general as follows: First, sugar-cane juice is collected in large jars at a mill. This juice is heated in open pans until it reaches a certain degree of concentration, which varies according to the quality of basi desired. When boiling begins, crushed leaves or powdered bark of binuñga is added to the juice. The scum is removed while the mixture boils. When a desired concentration has been reached, the syrup is poured into large jars (tinajas) and allowed to cool. On the following day, a considerable quantity of crushed binuñga leaves is put into the jars, which are then tightly covered. After two or three months, the crushed leaves are replaced by powdered bark, which is supposed to improve the flavor of the basi. The amount of bark used influences the quality very greatly, as increasing the quantity makes the basi more piquant and intoxicating. Aging is said to improve the quality. This is frequently done in jars, which are buried underground.

Other ingredients are sometimes added to the basi. The addition of the husks of cacao fruit or coffee beans makes the drink slightly bitter, powdered pepper gives it a pungent taste, while the bark of *Eugenia cumini* (duhat) is said to make it more astringent.

When binuñga bark is not available, the bark of kariskis, *Albizzia lebbekoides*, can be substituted. The leaves of kariskis are, however, not used, so other ingredients must be added.

Macaranga tanarius is a small tree reaching a height of 4 to 8 meters. The leaves are alternate, 10 to 25 centimeters long, shield-shaped, with the petiole attached to the lower surface within the margin.

This species is very common and widely distributed in open places and second-growth forests throughout the Philippines.

Family ANACARDIACEAE

Genus DRACONTOMELUM

DRACONTOMELUM DAO (Blanco.) Merr. & Rolfe. (Figs. 46, 47). DAÓ.

Local names: *Daó* (Bataan, Rizal, Laguna, Tayabas, Camarines, Albay, Sorsogon, Masbate, Samar, Negros, Leyte, Palawan, Mindoro, Cotabato, Zamboanga); *habás* (Butuan); *kamárak* or *kamárag* (N. Luzon); *lupigí* (Cagayan); *makadáeg* (Ilocos Norte); *mamákau* (Agusan, Davao); *mákau* (Agusan, Cotabato); *malaíyau* (Tayabas).

The fruits are yellow, rounded, about 2 centimeters in diameter, and have an edible pulp around the seed.

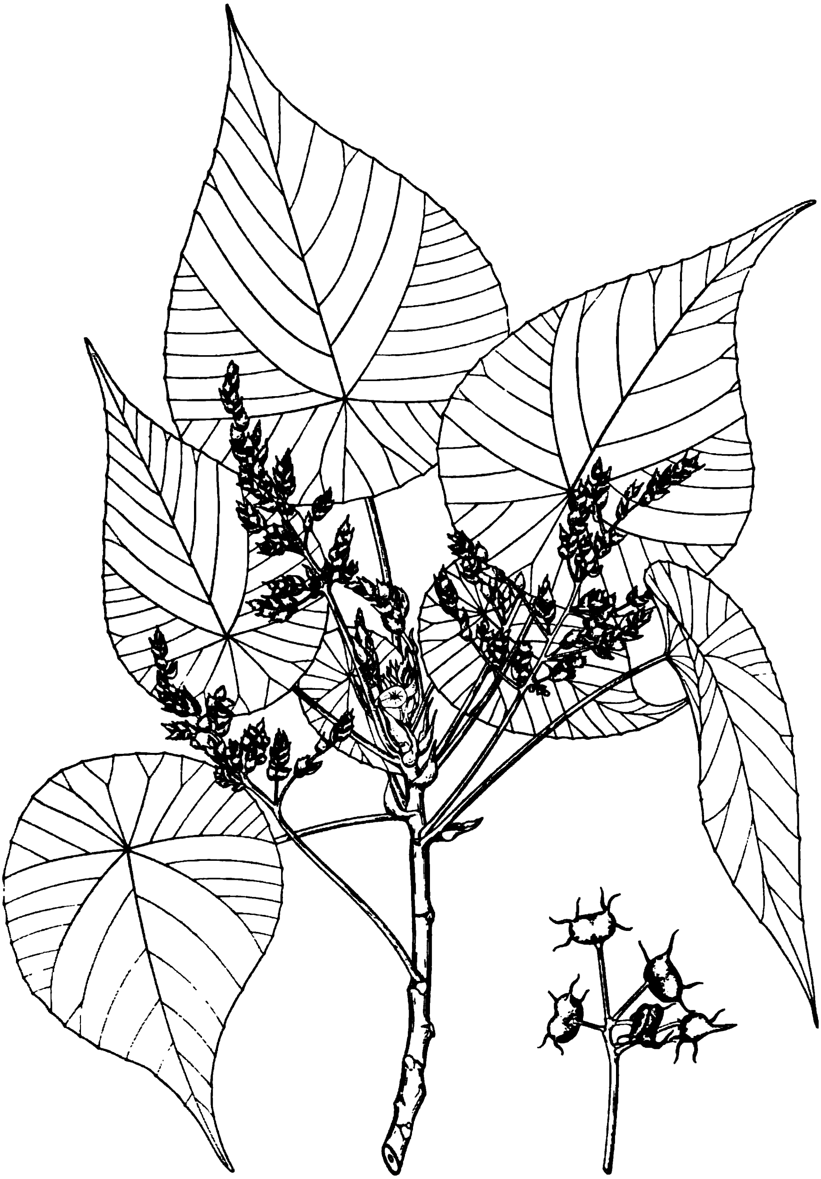

FIGURE 45. MACARANGA TANARIUS (BINUÑGA). ×⅓.

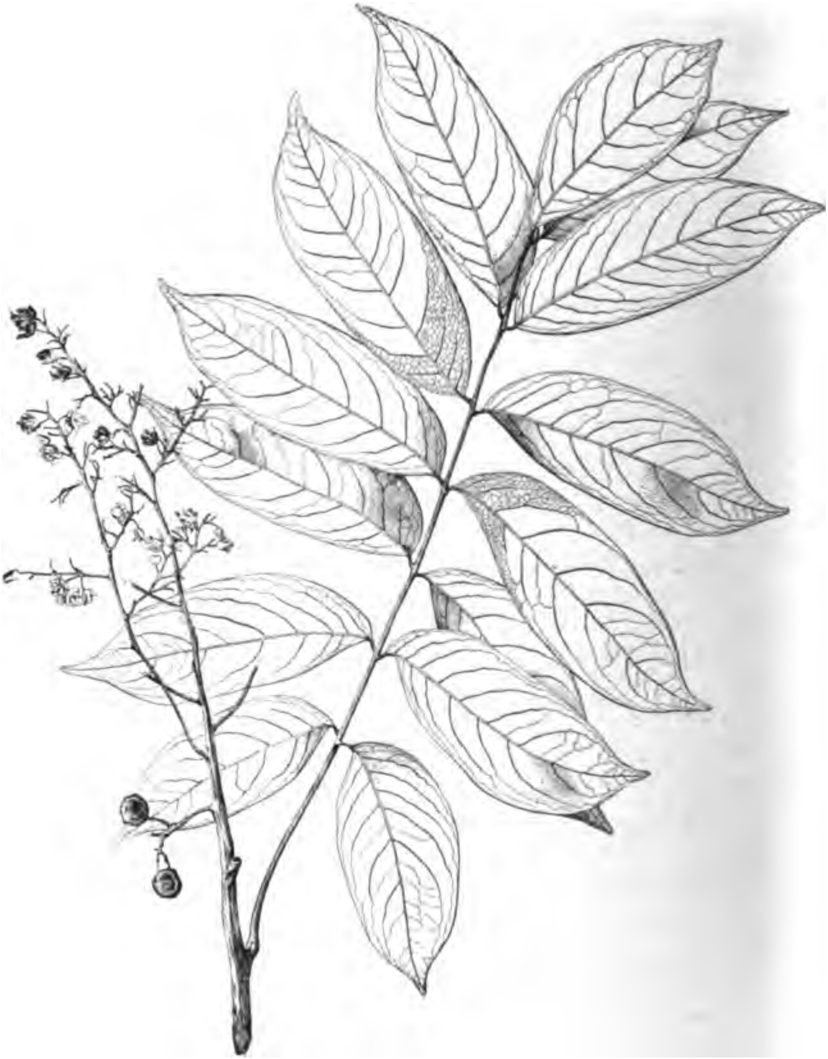

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FIGURE 46. DRACONTOMELUM DAO (DAO).

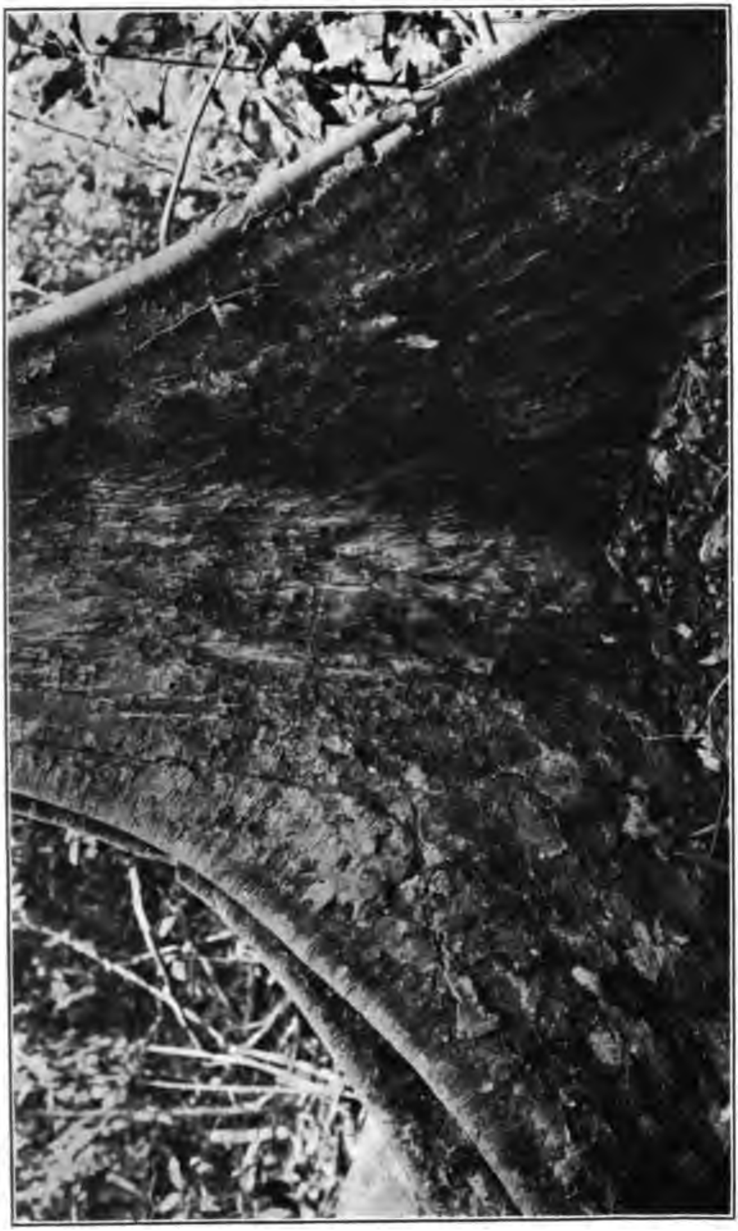

FIGURE 47. DRACONTOMELUM DAO (DAO).

Dracontomelum dao is a tree reaching a height of 35 to 40 meters and a diameter of 100 centimeters or more. The leaves are alternate and compound, usually with 5 to 7 pairs of leaflets. The leaflets are smooth, pointed at the apex, abruptly pointed at the base, 5 to 15 centimeters long, and from 3 to 4.5 centimeters wide. The flowers are small, white, odorless, and are borne on compound inflorescences.

This species is common and widely distributed throughout the Philippines.

DRACONTOMELUM EDULE (Blanco) Skeels. (Fig. 48). LAMIÓ.

Local names: *Aduás* (Rizal); *alauíhau* (Samar, Leyte); *amúgis* (Cotabato); *anánggíng-putí* (Tayabas); *balibali* (Tablas Island); *halauíhau* (Camarines); *lamió* (Bataan, Bulacan, Laguna).

The fruits are rounded, yellow, and have an edible pulp around the seed.

Dracontomelum edule is a tree reaching a height of about 20 meters and a diameter of about 60 centimeters. The leaves are alternate, pinnate, and hairy; the leaflets are pointed at the apex, rounded at the base, and from 10 to 20 centimeters in length. The flowers are small, and occur on rather large, compound inflorescences.

This species is common and distributed from northern Luzon to southern Mindanao.

Genus MANGIFERA

MANGIFERA ALTISSIMA Blanco. (Fig. 49). PAHÚTAN.

Local names: *Banitan, bumitan* (Cagayan); *malapáho* (Zambales, Sibuyan); *manggapóle* (Olutanga Island, Zamboanga); *pahuhútan* (Tayabas); *páho* (Nueva Ecija, Pangasinan, Bataan, Rizal, Camarines, Mindoro, Sibuyan, Samar); *pahútan, pahuhútan* (Tayabas, Camarines, Bataan, Zambales, Mindoro, Masbate); *pañgahútan* (Tayabas); *pangmanggáen* (Ilocos Sur).

The fruit is 5 to 8 centimeters long and 4 to 6 centimeters wide, shaped like a mango, smooth, green to yellowish, and resinous. It is used for making pickles.

Mangifera altissima is a tree reaching a height of 35 meters and a diameter of 80 centimeters. The leaves are rather long, narrow, and pointed at both ends. The flowers are small, white, fragrant, and occur in large number on branched inflorescences.

This species is rather common and is distributed in the forests from northern Luzon to southern Mindanao, but is not cultivated.

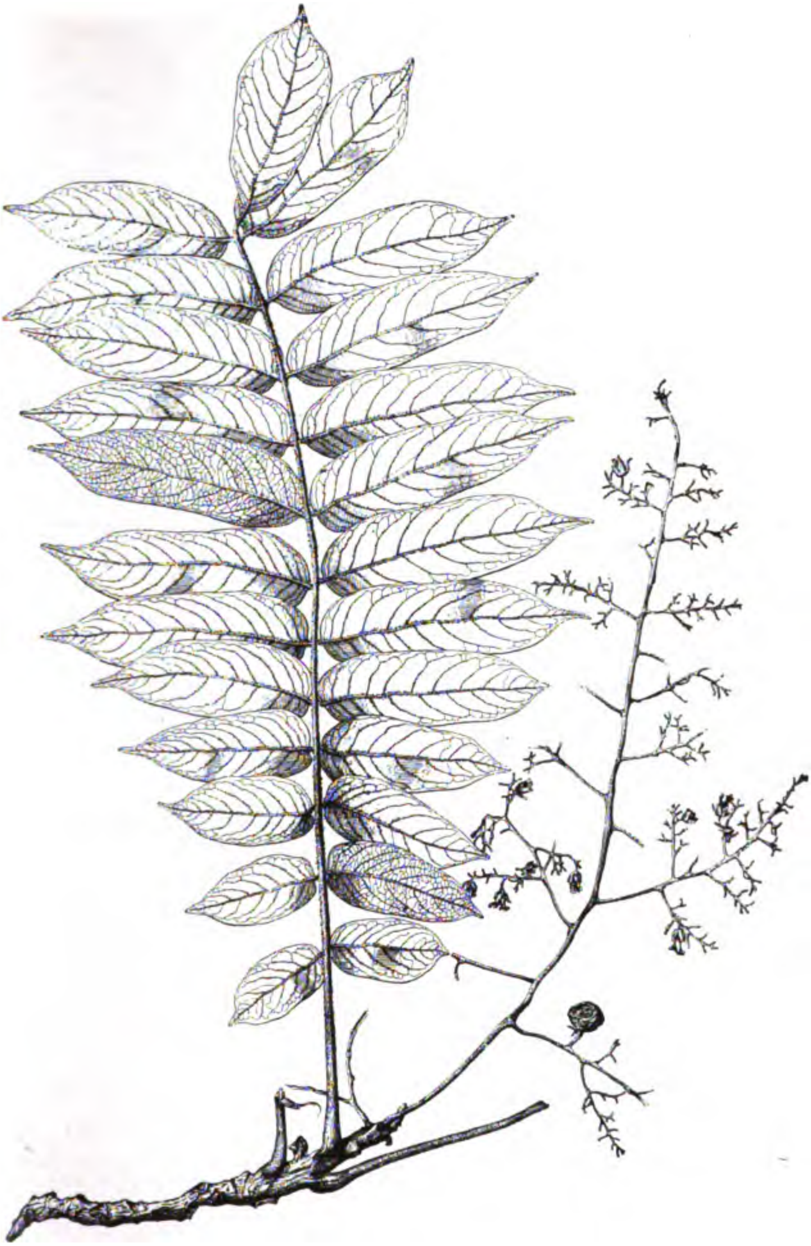

FIGURE 48. DRACONTOMELUM EDULE (LAMIO).

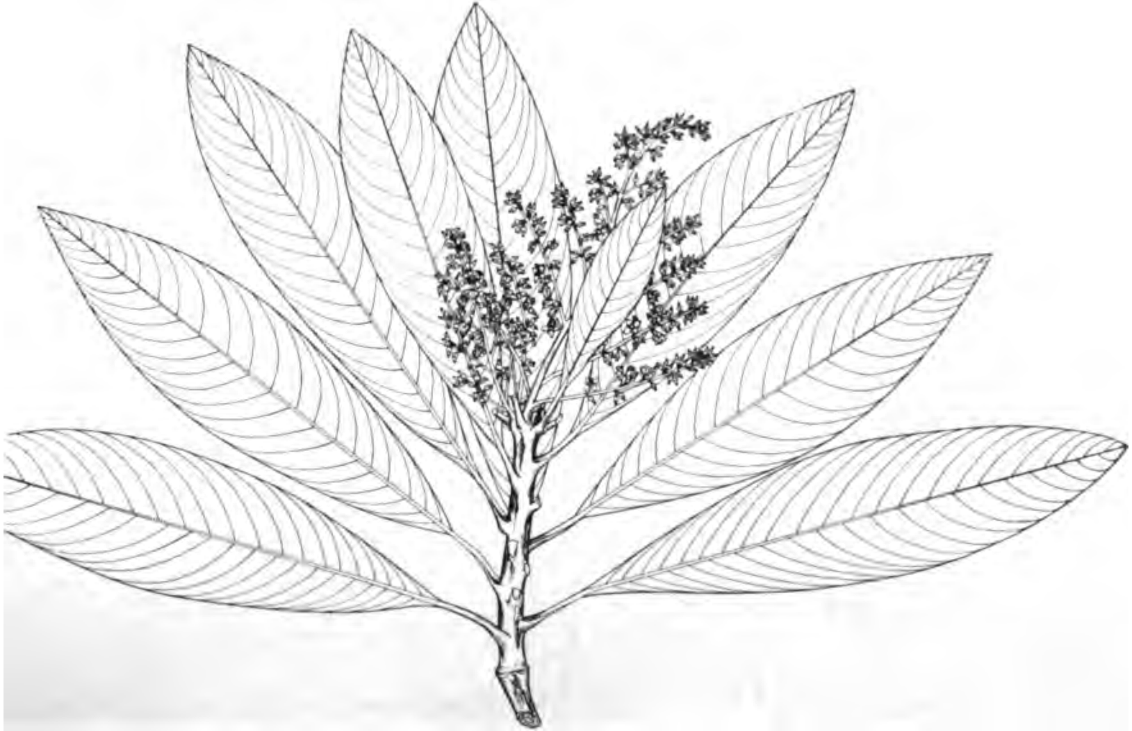

FIGURE 49. MANGIFERA ALTISSIMA (PAHUTAN). × ½.

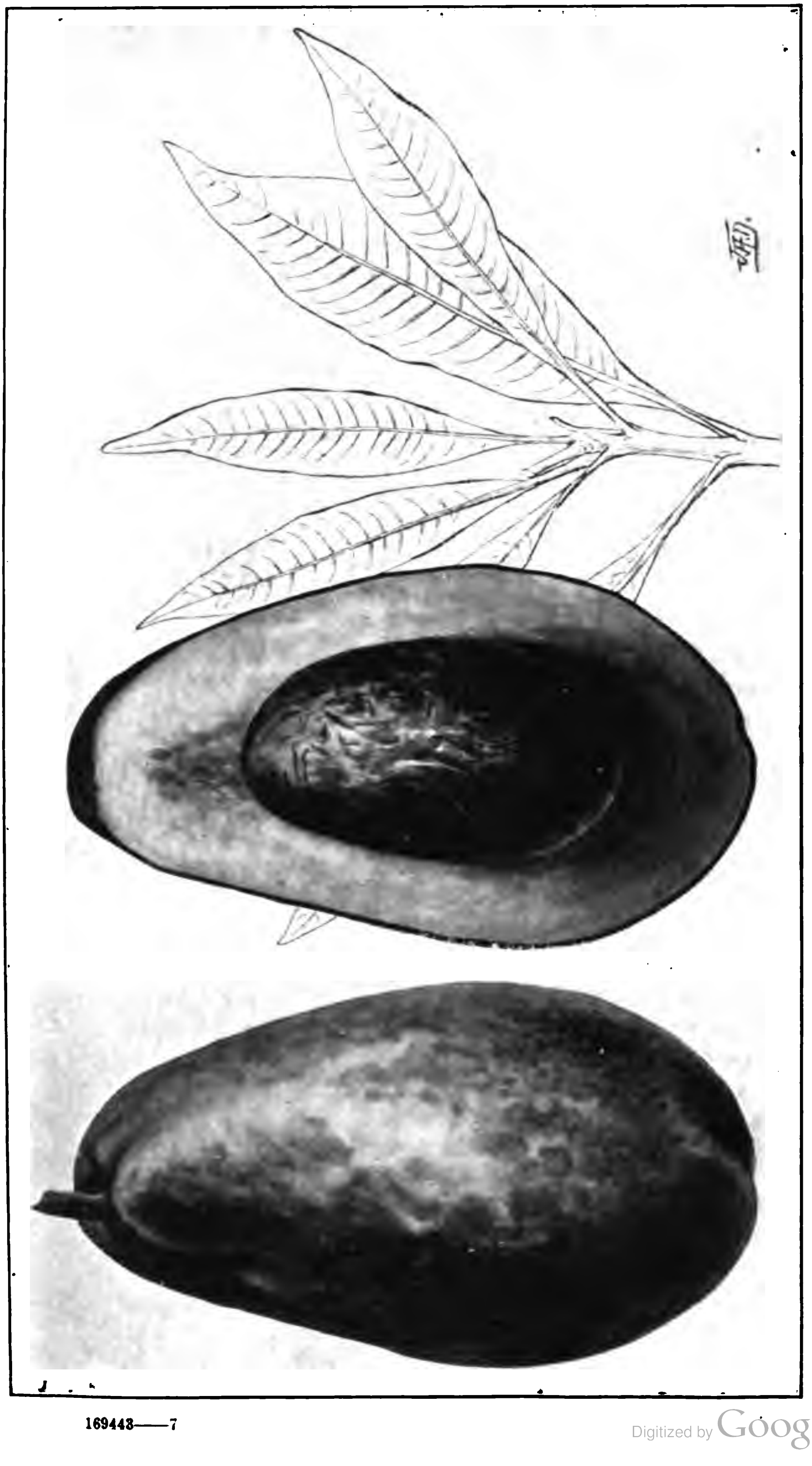

FIGURE 50. MANGIFERA CAESIA (BALUNO).

MANGIFERA CAESIA Jack. (Fig. 50). **BALÚNO.**

Local names: *Balúno* (Zamboanga); *baúno* (Basilan).

The fruit resembles the commonly cultivated mango and is sold in the markets of Zamboanga. The tree is sometimes cultivated for the fruits.

According to Heyne,* the seed kernels are pounded with leaves of *Solanum nigrum*, and used as a condiment with rice.

Mangifera caesia is a tree reaching a height of about 25 meters and a diameter of about 120 centimeters. The leaves are smooth, and pointed at both ends.

This species is found in Mindanao and neighboring islands, and in the Sulu Archipelago.

MANGIFERA ODORATA Griff. **HUANÍ.**

Local names: *Huaní* (Zamboanga); *uaní* (Basilan).

The fruit of this species is similar to that of the cultivated mango.

Mangifera odorata is a tree reaching a height of about 25 meters and a diameter of about 40 centimeters. The leaves are alternate, leathery, pointed at both ends, and about 25 centimeters in length. The flowers are small and borne on rather large, compound inflorescences.

This species has been reported from Balabac, Zamboanga, and Basilan. It is cultivated at the Lamao Experiment Station.

Genus SEMECARPUS

SEMECARPUS CUNEIFORMIS Blanco. (Fig. 51). **LIGÁS.**

Local names: *Agás* (Guimaras Island); *anagás* (Negros Occidental); *kamíing* (Zambales, Pampanga, Bataan); *kamíring* (Ilocos Sur, Abra, Cagayan, Union, Pangasinan); *ligás* (Nueva Ecija, Bataan, Manila, Rizal, Mindoro); *pakan* (Bontoc).

The fruit resembles the cashew in form, but is smaller. The drupe is ovoid, oblique, a centimeter long, and is borne on a fleshy, purple receptacle, which is about as long as the drupe.

Semecarpus cuneiformis is a tree reaching a height of about 12 meters and a diameter of about 25 centimeters. The leaves are somewhat crowded at the ends of the branches, hairy beneath, rounded or somewhat pointed at the tip, usually pointed at the base, and from 10 to 20 centimeters in length. The flowers are

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 3, page 125.

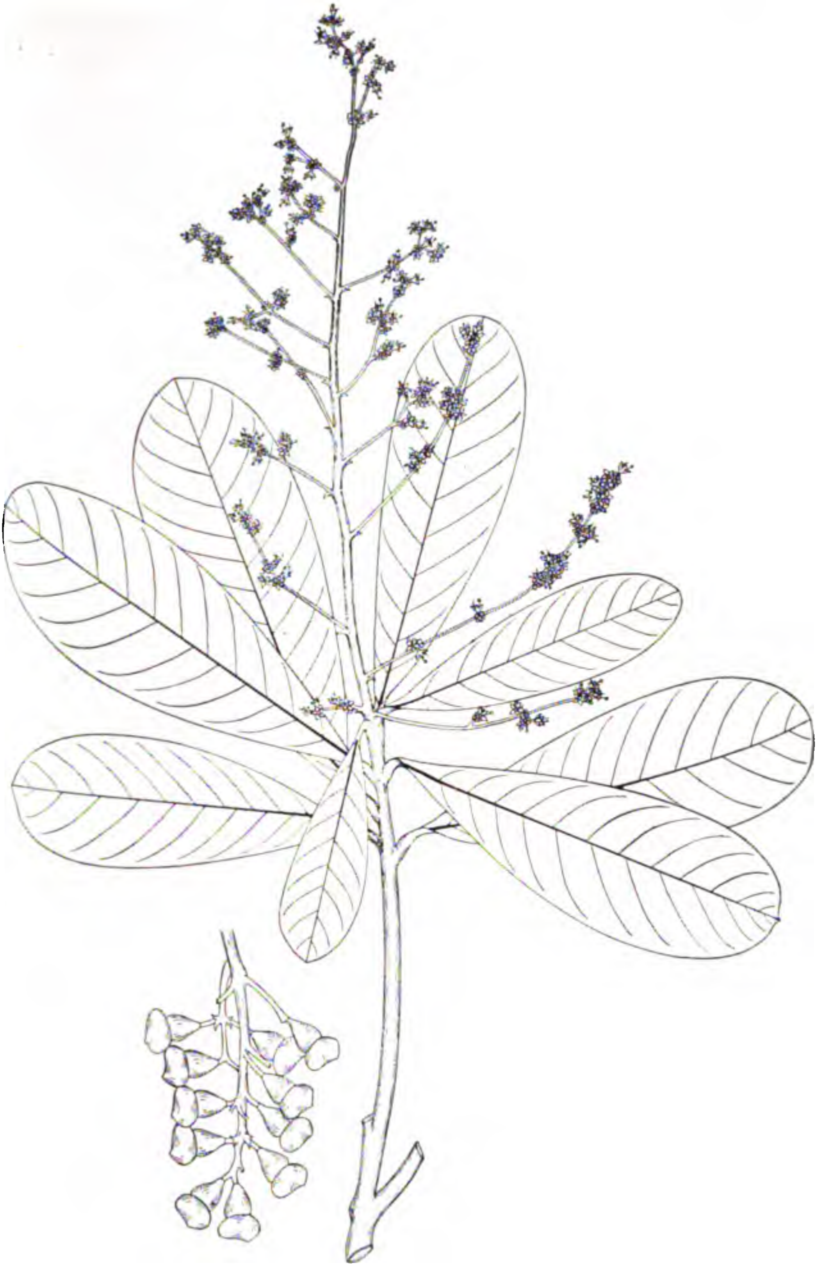

FIGURE 51. SEMECARPUS CUNEIFORMIS (LIGAS). ×½.

whitish, 2 to 2.5 centimeters long, and borne on compound inflorescences which are usually longer than the leaves.

This species is common and widely distributed in the Philippines, but has not been reported from Mindanao. It is not in cultivation.

SEMECARPUS GIGANTIFOLIA F. Vill. (Fig. 52). **MANALU.**

Local names: *Anagás,* (Mindoro); *ligás* (Laguna); *manalu* (Bisaya); *niog-nióg an* (Tayabas); *topó* (Camarines); *túkud-lan͠git* (Bataan).

The fruits are 3 to 4 centimeters long, deep purple, fleshy, juicy, edible, but somewhat astringent. They are produced in great abundance on the trunk, in panicles which are 10 to 40 centimeters long or longer.

Semecarpus gigantifolia is a tree reaching a height of 15 meters and a diameter of 50 centimeters. The leaves are very large. The flowers are small, and borne in large numbers on compound inflorescences.

This species is common and distributed in the forests from Luzon to Mindanao.

Genus SPONDIAS

SPONDIAS PINNATA (L. f.) Kurz. (Fig. 53). **LIBÁS.**

Local names: *Lannú, lanó* (Cagayan); *libás* (Bataan, Tayabas, Capiz, Cotabato, Zamboanga); *lubás* (Bikol).

The fruit is rounded, yellow, with a finely flavored, edible pulp. The leaves and fruits are sour, and are used in stews.

Spondias pinnata is a tree reaching a height of about 25 meters and a diameter of about 60 centimeters. The leaves are alternate, pinnate, 20 centimeters or more in length; the leaflets pointed at the apex, rounded or abruptly pointed at the base, and 7 to 14 centimeters in length.

This species is distributed from northern Luzon to southern Mindanao, but apparently is not common.

Family SAPINDACEAE

Genus CUBILIA

CUBILIA BLANCOI Blume. **KUBILÍ.**

Local names: *Atilang* (Nueva Vizcaya); *kamatatalina, lubilúbi* (Rizal); *kubilí* (Bulacan, Rizal); *malaságing* (Bulacan); *tabas* (Samar).

The fruit is oval, about 5 centimeters long, and covered with very numerous, pointed projections. It contains a nut of good quality.

Cubilia blancoi is a tree reaching a height of 15 meters and a diameter of 50 centimeters. The leaves are compound with rather large leaflets which are smooth and pointed at both ends.

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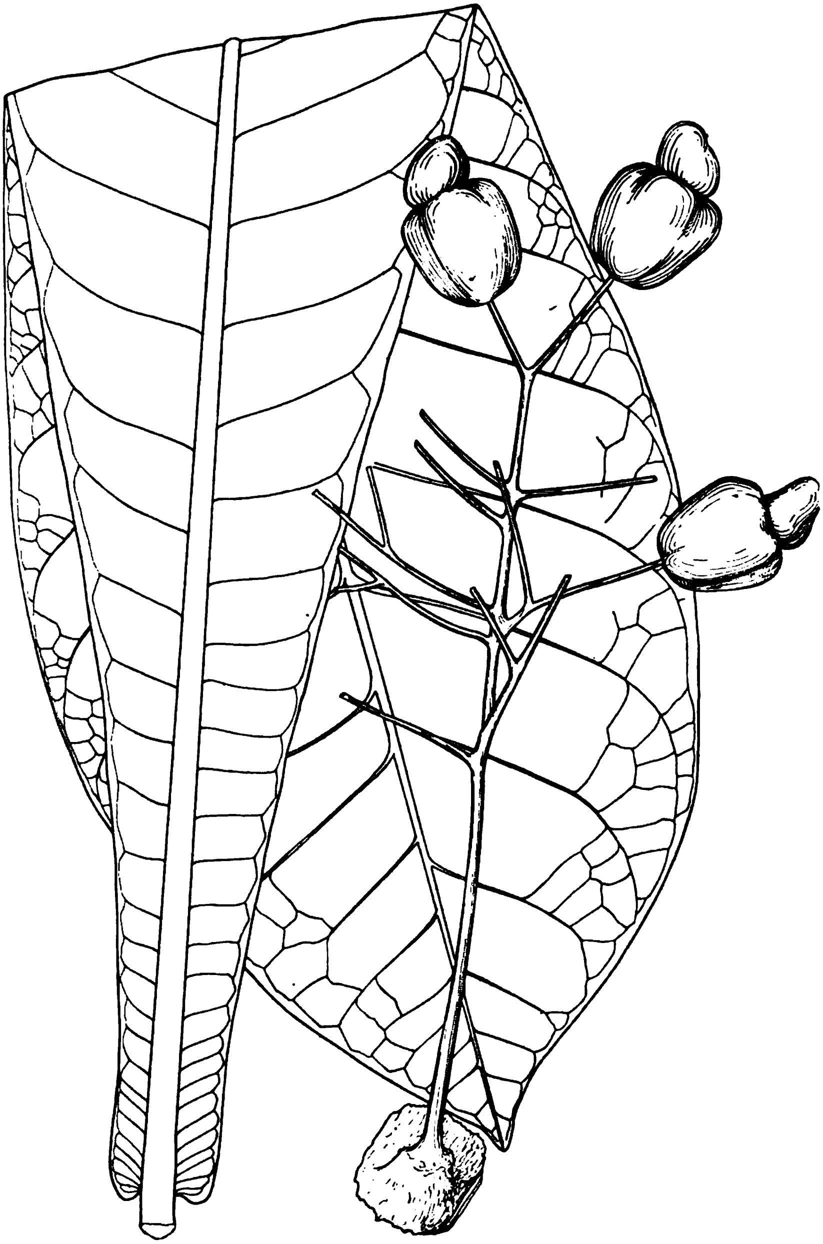

FIGURE 52. SEMECARPUS GIGANTIFOLIA (MANALU). X½.

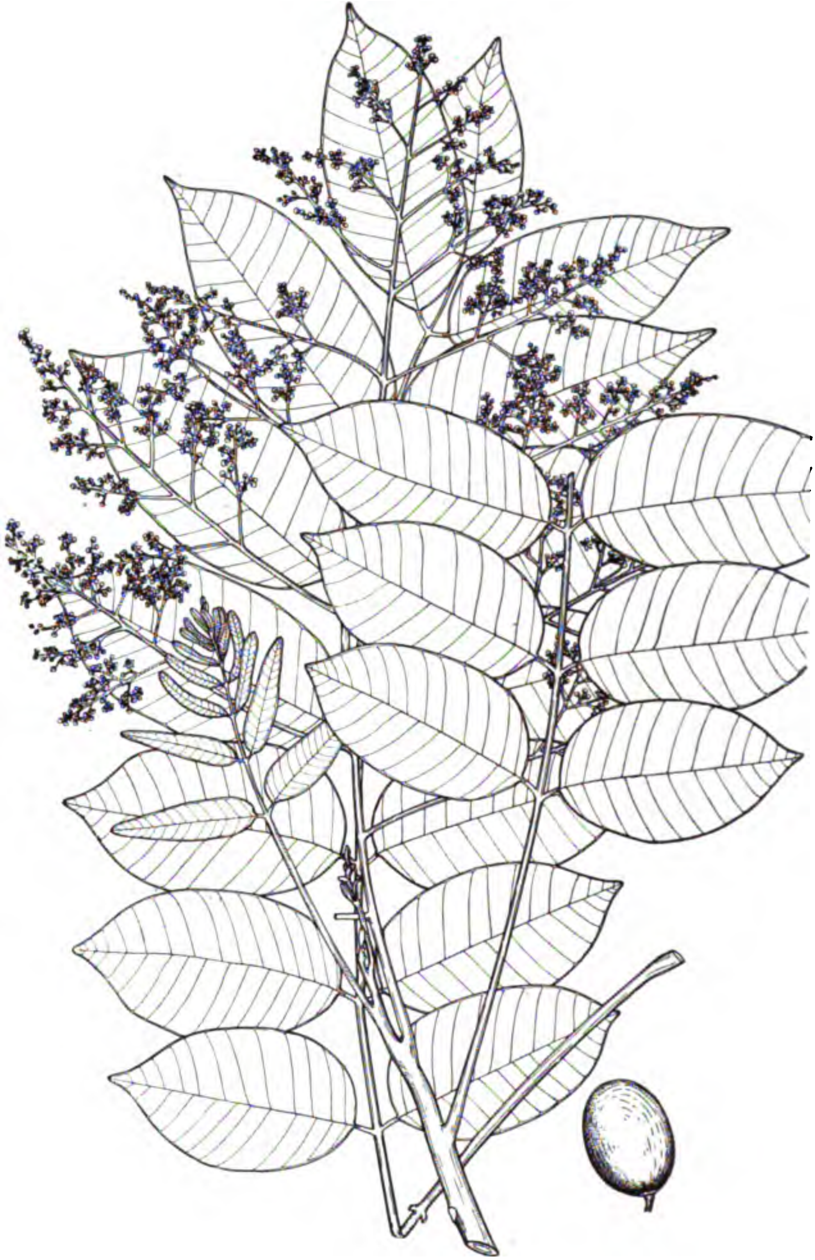

FIGURE 53. SPONDIAS PINNATA (LIBAS). ×⅜.

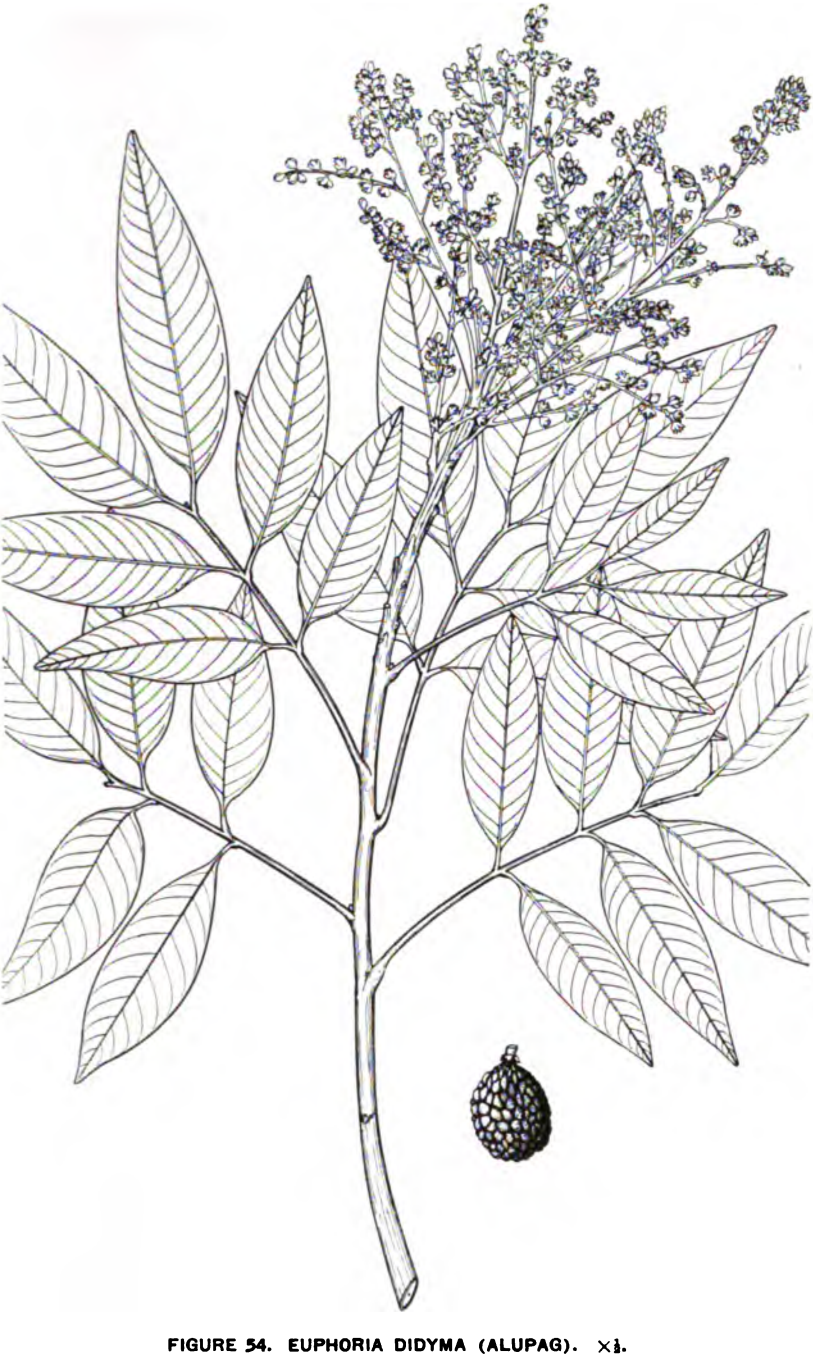

FIGURE 54. EUPHORIA DIDYMA (ALUPAG). ×½.

The flowers are small and are borne on rather large inflorescences.

This species is distributed from Luzon to Mindanao.

Genus EUPHORIA

EUPHORIA DIDYMA Blanco. (Fig. 54). ALUPÁG.

Local names: *Alupág* (Mindoro, Bataan, Tayabas, Lanao, Laguna, Marinduque Island, Cavite, Batangas, Basilan, Malani Island); *alupág-amó*, *bayyét*, *baít* (Tayabas); *alupái* (Bulacan, Mindoro, Nueva Ecija, Pampanga, Rizal); *alupák* (Zamboanga, Bataan, Rizal); *aniñguái*, *balinkañgin*, *bakeles* (Pangasinan); *apalung*, *marutong*, *demopa* (Cagayan); *arupág*, *ayupág* (Mindoro); *arupái* (Rizal, Laguna, Mindoro); *bakkaláu* or *bakaláu* (Pangasinan, Ilocos Norte and Sur, Zambales); *balít* (Negros); *buk-kaláu* (Ilocos Sur, Abra, Cagayan, Isabela); *dagingdíñgan* (Samar); *gisíhan* (Cavite, Batangas); *halupág* (Polillo, Laguna, Tayabas); *kalupái* (Zambales); *kandongisól*, *panuto* (Masbate); *kukuris* (Palawan); *lupák* (Camarines); *lupák* (Cotabato); *mamatá* (Olutanga Island); *matamatá* (Zamboanga); *usáu*, *uláyan* (Leyte).

The fruits are greenish, very rough, and occur in loose clusters. They are similar in appearance to the Chinese litchi. The flesh is whitish, sweet, juicy, and of good flavor.

Euphoria didyma is a tree reaching a height of 25 meters and a diameter of 55 centimeters. The leaves are alternate and compound. The flowers are small, whitish or yellowish, and borne on simple or compound inflorescences.

This species is very common and widely distributed throughout the Archipelago. It is rarely cultivated.

EUPHORIA NEPHELIOIDES Radlk.

The pulp around the seed is edible.

Euphoria nephelioides is a tree reaching a height of about 25 meters and a diameter of about 40 centimeters. The leaves are alternate and compound, with leathery leaflets, which are pointed at both ends.

This species has been reported only from Basilan.

Genus HEDYACHRAS

HEDYACHRAS PHILIPPINENSIS Radlk.

The fruit of this species is 5 to 6 centimeters in diameter, shaped somewhat like a peach, yellow, smooth, thin-skinned, fleshy, subacid, and edible though a trifle astringent, and contains two large seeds.

Hedyachras philippinensis is a tree about 15 meters in height. The leaves are alternate and compound with 4 to 5 pairs of opposite leaflets which are pointed at the apex, rounded or pointed at the base, and 10 to 12 centimeters in length. The flowers are

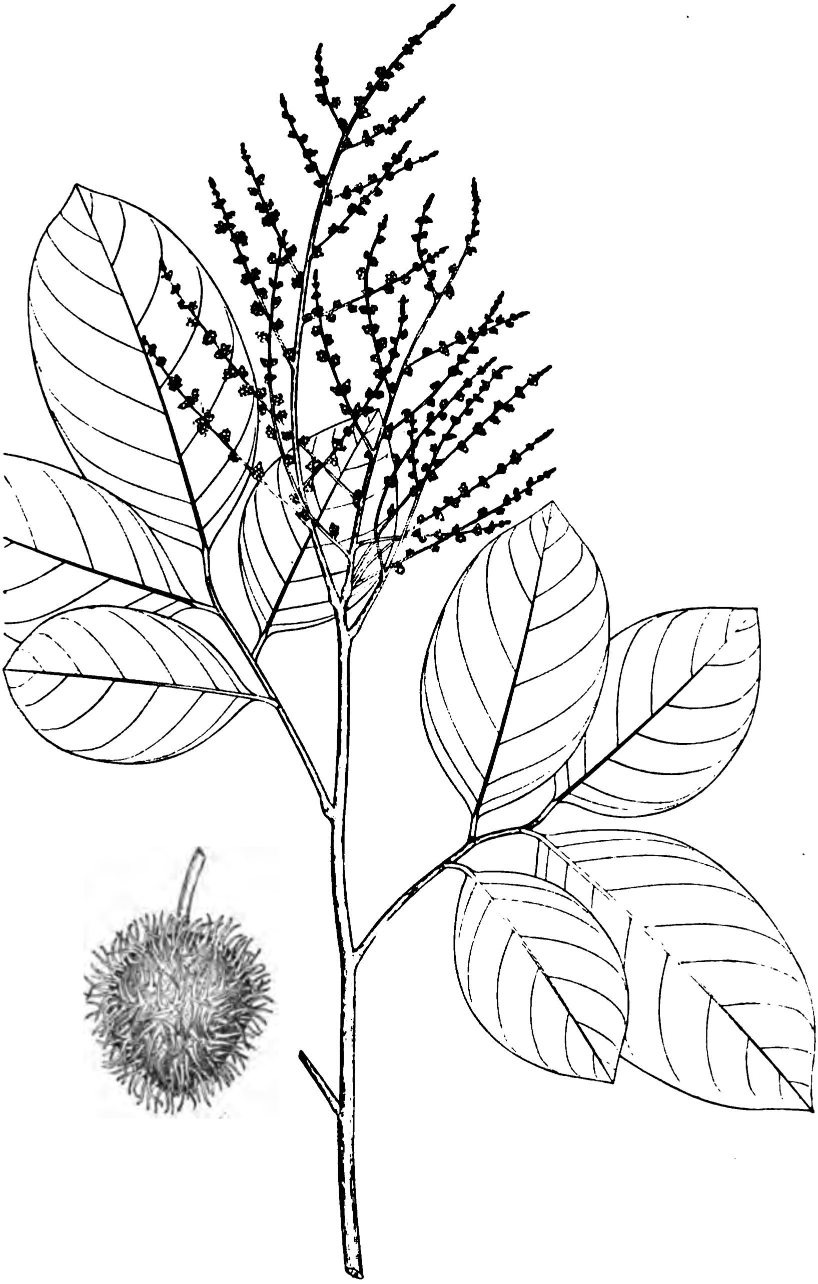

FIGURE 55. NEPHELIUM LAPPACEUM (USAU OR RAMBUTAN). ×½.

small, greenish, with a disagreeable odor, and occur in considerable numbers on compound flowering shoots.

This species is known from only one specimen which was found growing wild on what is now the campus of the College of Agriculture at Los Baños, Laguna.

Genus NEPHELIUM

NEPHELIUM LAPPACEUM L. (Fig. 55). USÁU or RAMBUTÁN.

Local name: *Usáu* (Jolo).

The pulp of the fruit has an excellent flavor.

Nephelium lappaceum is a tree. The leaves are smooth, pointed at the tip, and somewhat rounded at the base. The flowers are very numerous on compound inflorescences. In the Philippines, this species is found only in Palawan and Jolo. It is the well known Rambutan of the Malay region.

NEPHELIUM MUTABILE Blanco. (Fig. 56). BULÁLA.

Local names: *Alpái* (Laguna); *bakaláu* (Pangasinan); *balimbiñgan* (Lanao); *bulála* (Camarines, Tayabas, Laguna, Rizal); *kakao-kakao* (Surigao); *karayo* (Mindoro); *laguan* (Tayabas); *malamputían* (Samar); *marañgis* (Cagayan); *pangyáu* (Rizal).

The fruits are red, about 4 centimeters in length, and completely covered with numerous, rather soft projections. The flesh is white, abundant, juicy, and of very good flavor. It surrounds a single, rather large seed.

Nephelium mutabile is a tree reaching a height of about 25 meters and a diameter of 45 centimeters. The leaves are alternate and compound with rather large, smooth, alternate leaflets, which are pointed at both ends. The flowers are small, and occur in considerable numbers on simple or compound inflorescences.

This species is distributed from northern Luzon to southern Mindanao and is very common in Luzon.

Family VITACEAE

Genus AMPELOCISSUS

AMPELOCISSUS MARTINI Planch.

The fruits of this species are borne in grape-like clusters, are somewhat less than a centimeter in diameter, greenish salmon in color, fleshy, acid, and of fairly good flavor.

Ampelocissus martini is a large woody vine with conspicuous tendrils. The leaves are somewhat hairy, three-lobed, with toothed margins, and a russet, velvety lower surface. The

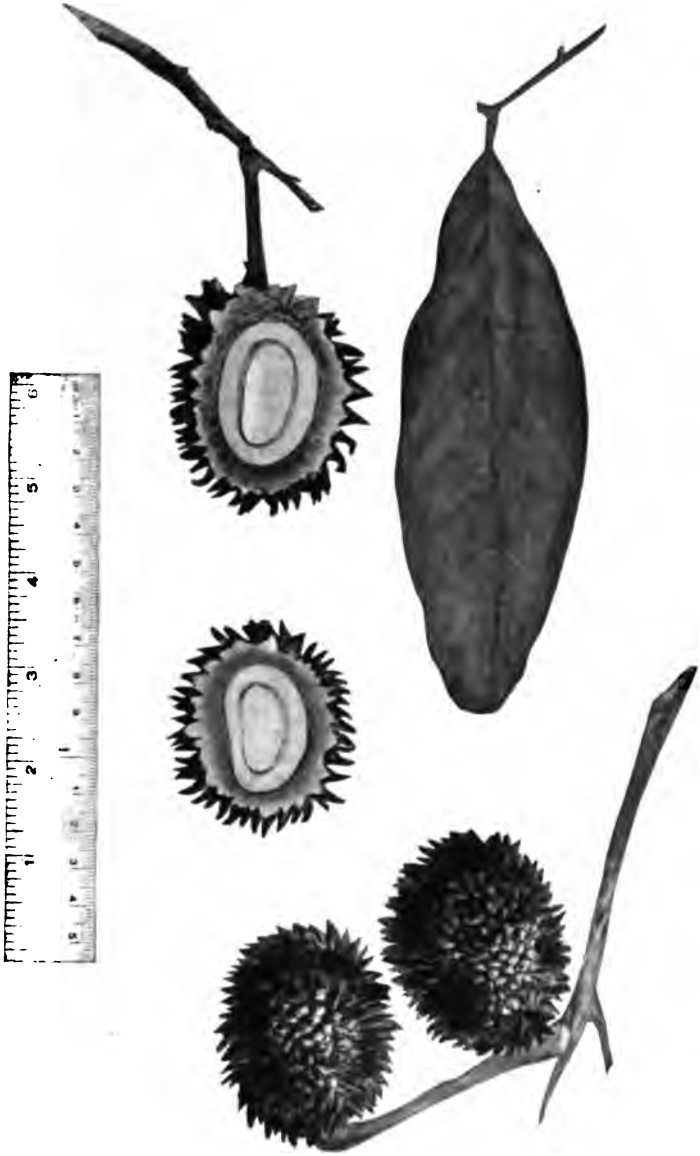

FIGURE 56. NEPHELIUM MUTABILE (BULALA).

flowers are small, reddish purple, and crowded on compound flowering branches.

This species is distributed from Luzon to Palawan, but is apparently not abundant.

Genus TETRASTIGMA

TETRASTIGMA HARMANDII Pl. AYO.

Local names: *Ayo* (Bataan, Bulacan); *ariuat* (La Union, Pangasinan, Abra); *kalít* (Tayabas); *iyo* (Bataan).

The fruits are edible. The sour leaves and fruits are used for flavoring.

Tetrastigma harmandii is a woody vine reaching 10 meters in length. The stems are somewhat compressed, rough, and 1 to 2.5 centimeters in diameter. It climbs by means of simple tendrils. The leaves are alternate and compound with usually 3 or 5, but sometimes 7 leaflets. The leaflets are pointed at the tip, coarsely toothed, smooth, shiny, and 5 to 12 centimeters in length. The flowering shoots are 4 to 10 centimeters long and wide. The flowers are pale green, fragrant, and numerous. The petals are about 3.5 millimeters long. The fruit is rounded, smooth, fleshy, and more than a centimeter and a half in diameter.

This species is common in Luzon and is also found in Mindoro and Leyte. In Manila it is occasionally cultivated for ornamental purposes.

TETRASTIGMA LOHERI Gagnep. BARIUATUÁT.

Local name: *Bariuatuát* (Ilocos Norte).

The sour leaves are used as flavoring. The fruits are edible.

Tetrastigma loheri is a woody vine. It climbs by means of simple tendrils. The leaves are alternate and compound with 3 leaflets which are pointed at the tip, rounded or pointed at the base, coarsely toothed, and from 7 to 20 centimeters in length. The flowers are small, pale yellow, and occur in rounded clusters. The fruits are round, fleshy, and about a centimeter in diameter.

This species is found in Luzon.

Family ELAEOCARPACEAE

Genus ELAEOCARPUS

ELAEOCARPUS CALOMALA (Blanco) Merr. KALOMALA.

A description of this species and its local names are given in the bulletin on fibers.

The fruit is oval, red, about 2.5 to 3 centimeters long; contains a single, large, rough stone, and is edible.

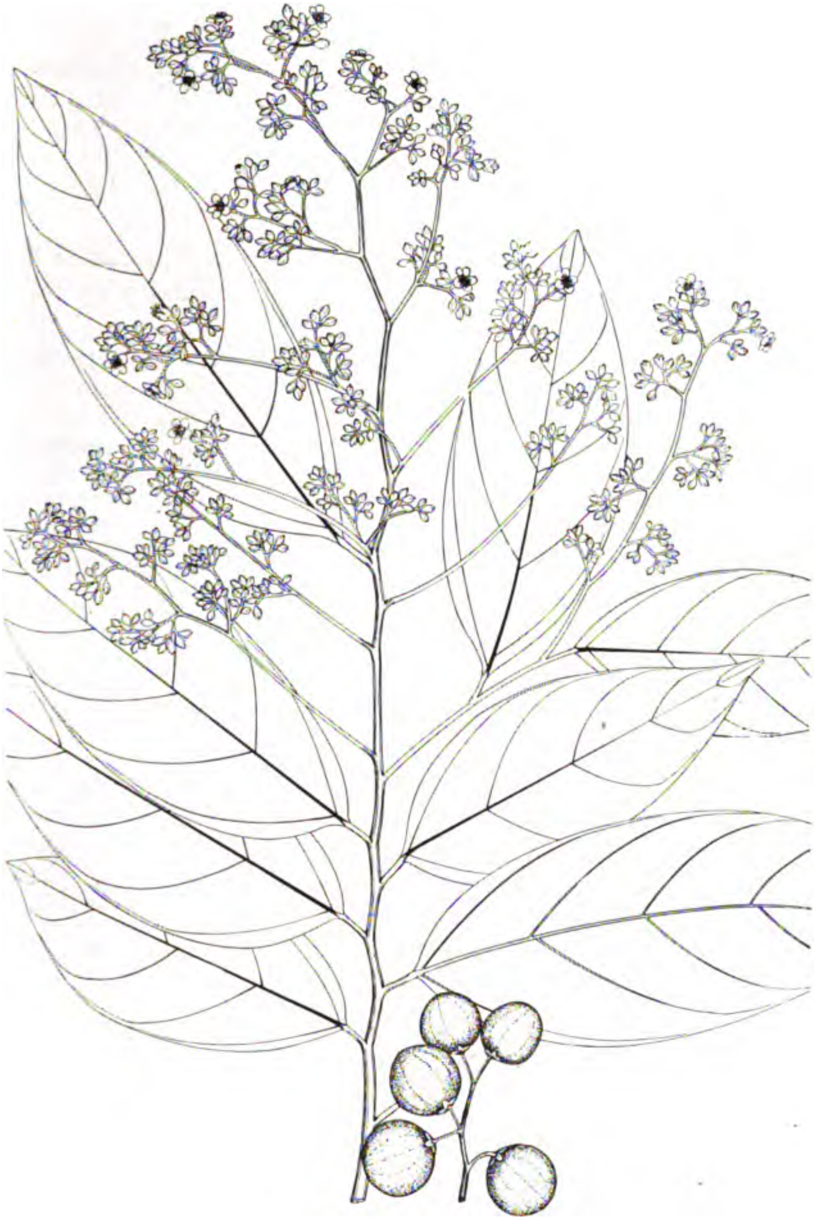

FIGURE 57. DIPLODISCUS PANICULATUS (BALOBO). ×⅔.

Genus MUNTINGIA

MUNTINGIA CALABURA L. DÁTILES.

A description of this species and its local names are given in the bulletin on fibers.

The fruits are round, smooth, red, about 1.5 centimeters in diameter, sweet, fleshy, and contain numerous, small seeds. The fruits are very commonly eaten by children.

Family TILIACEAE

Genus CORCHORUS

CORCHORUS OLITORIUS Linn. PÁSAU or JUTE.

A description of this species and its local names are given in the bulletin on fibers.

The leaves of this species are cooked and eaten as a vegetable.

Genus DIPLODISCUS

DIPLODISCUS PANICULATUS Turcz. (Fig. 57). BALOBÓ.

A description of this species and its local names are given in the bulletin on fibers.

The starchy seeds when boiled have a good flavor. When the fruits are mature they can frequently be gathered in very large quantities with little labor.

Genus GREWIA

GREWIA EDULIS Merr. (Fig. 58). BALUKÓK.

Local names: *Anakseng* (Pangasinan); *bagiod* (Ilocos Sur); *balukók* (Tagalog).

The fruits are about 2 centimeters in diameter, yellowish, and of good flavor.

Grewia edulis is a small tree with alternate leaves which are pointed at both ends. The leaves are somewhat hairy, particularly on the lower surfaces.

This species has been reported from Ilocos Norte, Ilocos Sur, Pangasinan, Nueva Ecija, and Batangas.

GREWIA ERIOCARPA Juss. (*G. negrosensis*) (Fig. 59). BARIUÁN.

A description of this species and its local names are given in the bulletin on fibers.

The fruit is small, round, bluish, and edible.

GREWIA STYLOCARPA Warb. (Fig. 60). KAMÚLING.

Local names: *Agdang, susumbíg* (Laguna); *apung, balopo, kamuling* Camarines); *balobo* (Rizal); *balebagun-gubat, sósong-dalága, patling* (Zambales); *balit* (Negros); *balobo* (Lanao); *barobo* (Samar); *basilalag* (Isabela); *balsakan* (Tayabas); *kalumpit-puti* (Batangas); *lanutan-puti* (Ticao); *lapnisan* (Leyte); *makaya* (Palawan); *moling-moling* (Tayabas,

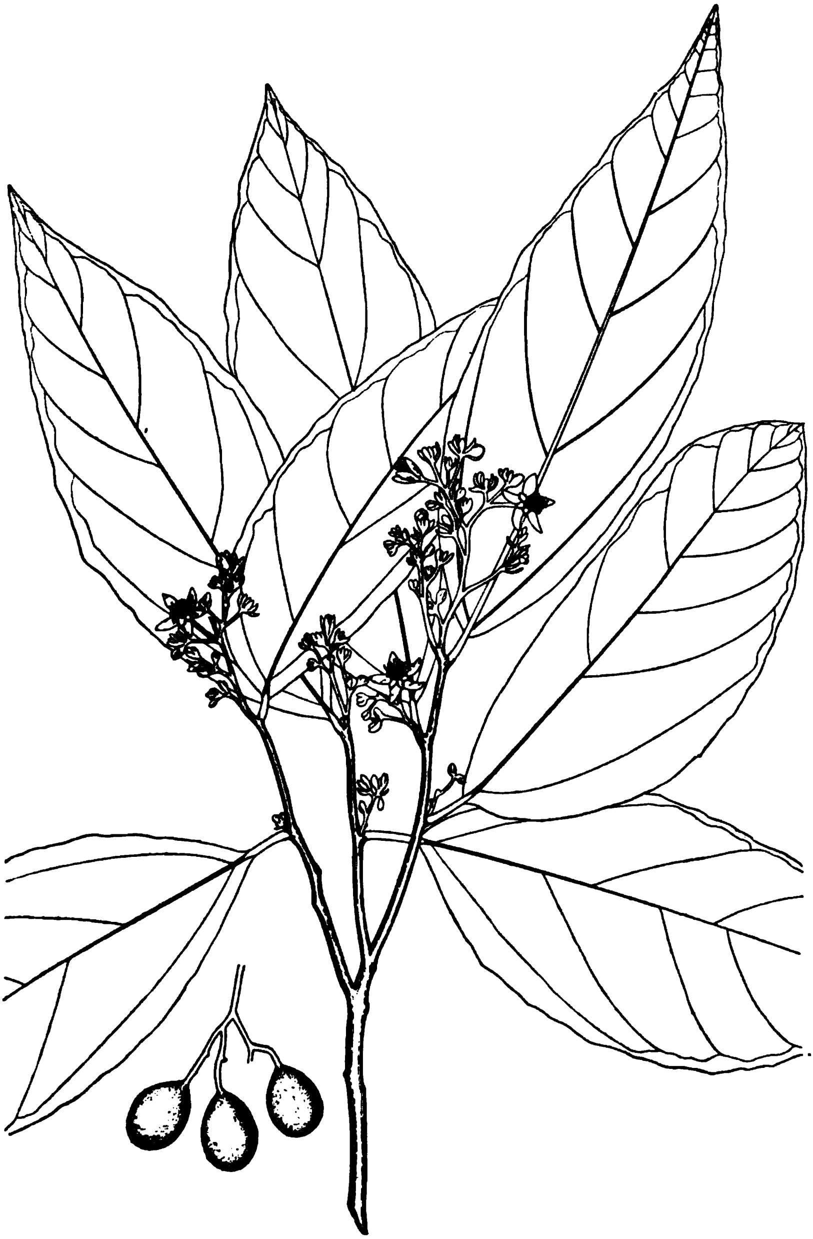

FIGURE 58. GREWIA EDULIS (BALUKOK). ×½.

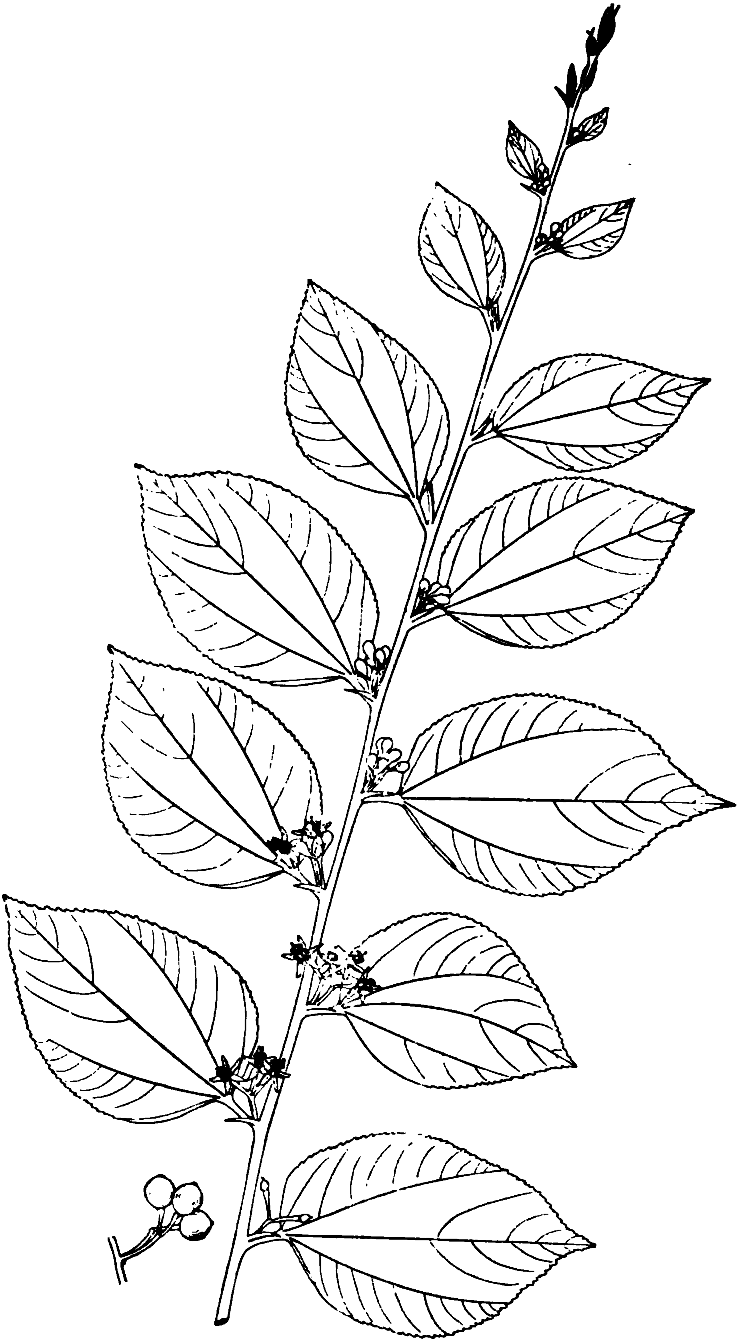

FIGURE 59. GREWIA ERIOCARPA (BARIUAN). X½.

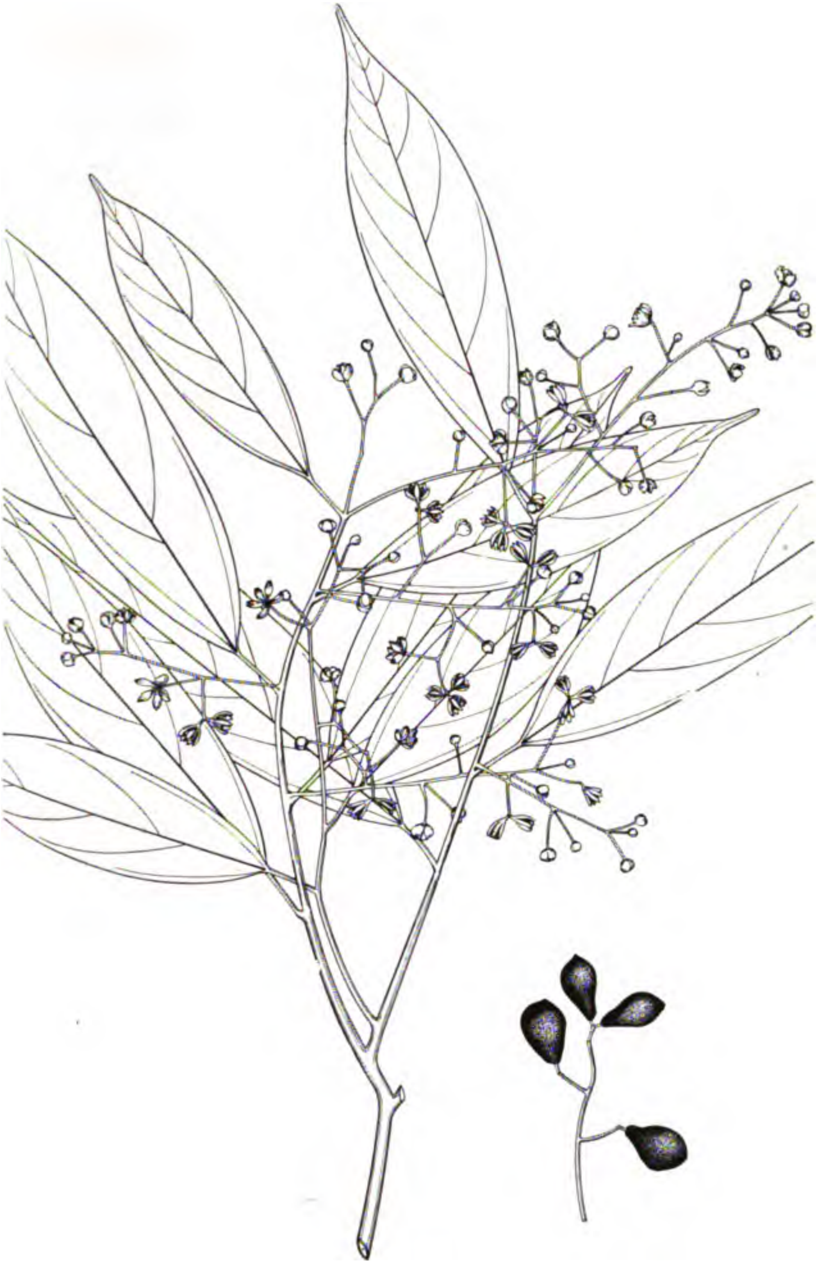

FIGURE 60. GREWIA STYLOCARPA (KAMULING). ×½.

Camarines); *namut* (Cagayan, Ilocos Norte); *ñgano* (Apayao); *paoli, puled, pulit* (Cagayan); *porong* (Mindoro, Negros); *susumbiik, susumbik, susungbiig* (Bataan).

The fruits have an edible pulp of good flavor.

Grewia stylocarpa is a tree reaching a height of 15 meters and a diameter of 30 centimeters. The leaves are alternate, pointed at both ends, and up to about 25 centimeters in length. The flowers are small, yellow, and borne on compound inflorescences.

This species is very common and widely distributed from northern Luzon to southern Mindanao.

Family MALVACEAE

Genus HIBISCUS

HIBISCUS SURATTENSIS Linn. LABUÁG.

Local names: *Kalitoitoi* (Palawan); *labuág* (Capiz); *sabnít, sapinit* (Rizal).

The acid leaves are cooked as a condiment with meat or fish.

Hibiscus surattensis is a spiny vine. The leaves are alternate, deeply lobed, somewhat hairy, have toothed margins, and are up to about 7 centimters in diameter. The flowers are large, yellowish or whitish, and tinged with red.

This species is distributed from northern Luzon to southern Mindanao.

Family STERCULIACEAE

Genus STERCULIA

STERCULIA FOETIDA L. KALUMPÁNG.

A description of this species and its local names are given in the bulletin on resins, gums, and oils.

The seeds are edible and have a purgative effect. They are flavored like cacao, but are not bitter, and are used to adulterate cacao.

STERCULIA OBLONGATA R. Br. (Fig. 61). MALABÓHO.

Local names: *Bakau* (Mindoro); *banílad* (Rizal, Mindoro); *boñga* (Tayabas); *buglás* (Rizal); *janták* (Batanes Islands); *lapnit* (Calayan Island); *malabóho* (Bataan); *malanbanílad* (Samar); *malakakáo* (Bataan, Laguna); *óos* or *úos* (Camarines); *pañgan* (Mountain Prov.); *saripong-póng* (Sorsogon).

The fruits are red, inflated, hairy, with a thick leathery covering, and contain a number of nuts which are eaten by the people of the Mountain Province.

Sterculia oblongata is a tree usually 12 meters or less in height. The leaves are smooth or nearly so, oblong, somewhat pointed

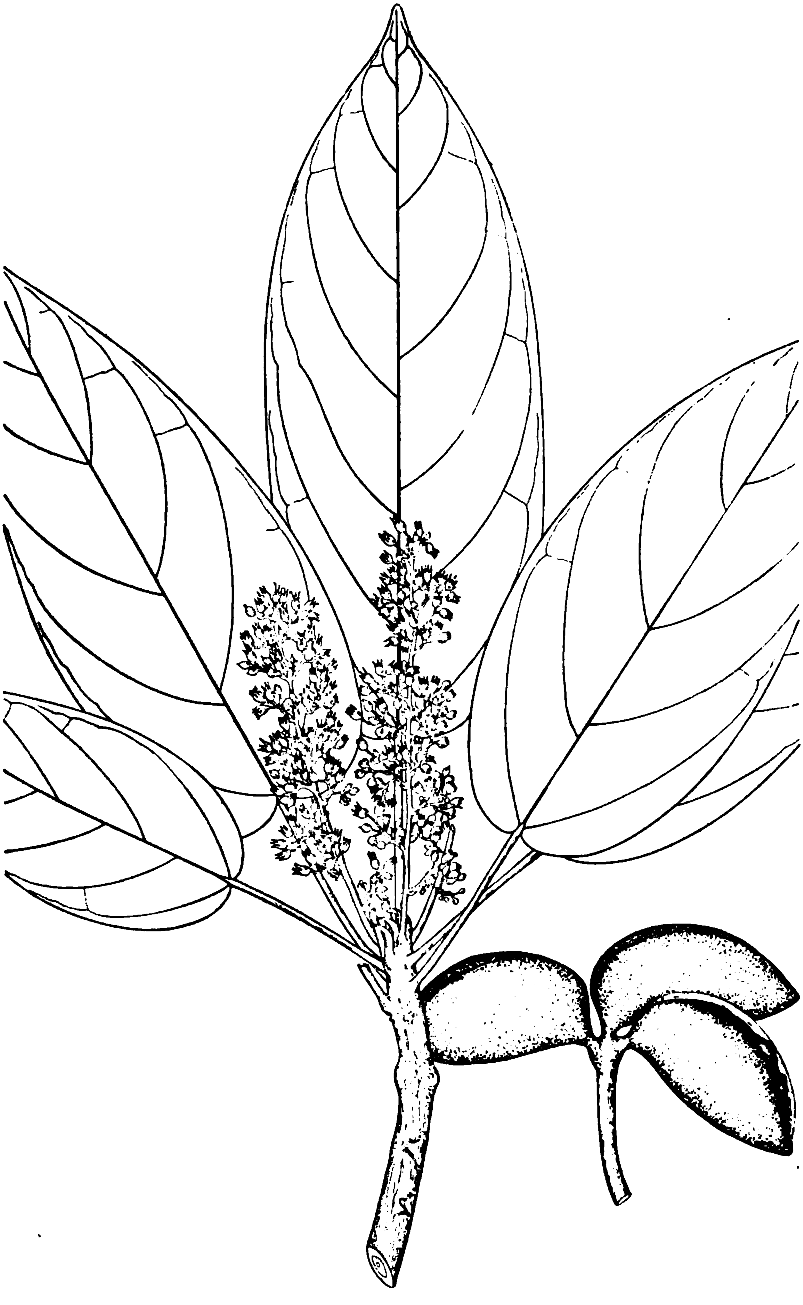

FIGURE 61. STERCULIA OBLONGATA (MALABOHO). ×½.

at the tip, rounded or heart-shaped at the base, and 10 to 20 centimeters long. The flowers are 5 to 6 millimeters long, somewhat hairy, and are borne in large numbers in narrow panicles in the axils of the upper leaves.

This species is common and widely distributed from the Batanes Islands to southern Mindanao. It is cultivated only at the Lamao Experiment Station.

Family DILLENIACEAE

Genus DILLENIA

DILLENIA MEGALANTHA Merr. KATMÓN-BAYÁNI.

Local names: *Katmón* (Leyte, Sorsogon, Samar, Camarines); *katmón-bayáni* (Tayabas).

The fruits are large and rounded. The edible part is green, fleshy, and juicy, with an acid taste. It is suitable for preserves.

Dillenia megalantha is a tree reaching a height of about 30 meters and a diameter of about a meter. The leaves are very large, and prominently toothed. The flowers are yellow, and about 10 centimeters in diameter.

This species has been reported only from Tayabas, Camarines, Sorsogon, Samar, and Leyte.

DILLENIA PHILIPPINENSIS Rolfe. (Figs. 62, 63). KATMÓN.

Local names: *Balobayáuak* (Negros); *biskán* (Benguet); *din̄gín* (Zambales); *kalambugi* (Lanao); *kambug* (Port Banga); *katmón* (Cagayan, Zambales, Nueva Ecija, Pampanga, Bataan, Rizal, Cavite, Batangas, Tayabas, Polillo, Camarines, Mindoro, Sorsogon, Guimaras Island, Masbate, Cebu, Samar, Agusan, Cotabato, Lanao, Zamboanga, Basilan); *palali* (Camiguin Island); *pamamalíen* (Pangasinan).

The fruit is rounded and contains a soft, fleshy, green pulp which is edible, with a flavor somewhat like that of an apple. The fresh fruit is not particularly good, but owing to its acid, juicy character, it is refreshing when eaten in the woods. It makes an excellent sauce or jam. It is also used for flavoring fish.

A red dye is obtained from the bark of this tree.

Dillenia philippinensis is a tree reaching a height of about 17 meters and a diameter of about 55 centimeters. The leaves are leathery, shiny, somewhat oval in shape, and coarsely toothed. The flowers are showy, about 15 centimeters in diameter, with large, white petals.

This species is very common and widely distributed in the Philippine Islands. It is a very ornamental tree, but is seldom cultivated.

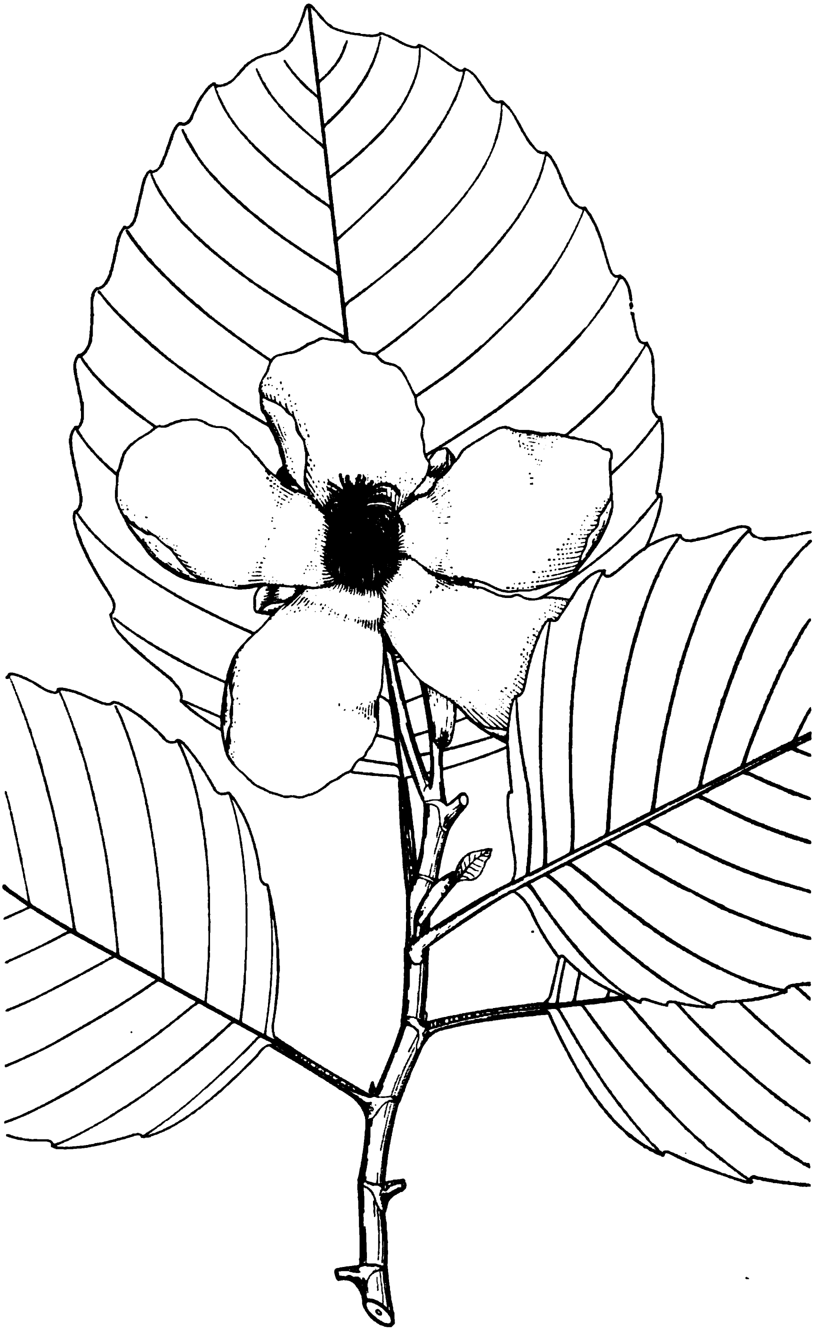

FIGURE 62. DILLENIA PHILIPPINENSIS (KATMON). ×½.

DILLENIA REIFFERSCHEIDIA F. Vill. KATMÓN-KALABÁU.

Local names: *Baláli* or *paláli* (Camarines); *katmón* (Rizal, Laguna, Tayabas, Mindoro, Negros); *katmón-kalabáu* (Tayabas, Laguna); *katmón-kadlagán* (Sorsogon).

The fruit is green, fleshy, and about the size of a small apple. The edible portion is green, juicy, acid, with something of the flavor of an apple. The taste of the fruit is not particularly good, but owing to its acid, juicy character, it is refreshing when eaten in the woods. It makes an excellent sauce or jam.

Dillenia reifferscheidia is a tree reaching a height of about 15 meters and a diameter of 45 centimeters. The leaves are alternate, smooth, and very large. The flowers are very large, white, and showy.

This species is distributed from central Luzon to southern Mindanao. It occurs most abundantly at medium elevations and in some places is very common.

Family GUTTIFERAE

Genus CALOPHYLLUM

CALOPHYLLUM INOPHYLLUM L. BITÁOG or PALOMARIA.

A description of this species and its local names are given in the bulletin on resins, gums, and oils.

The thin, rounded shells of the seeds of *Calophyllum inophyllum* are used as containers for buri sugar sold as a confection. For a description of this sugar see the bulletin on palms.

Genus GARCINIA

GARCINIA BINUCAO Choicy. (Fig. 64). BINÚKAU.

Local names: *Ballók* (Benguet); *balukut* (Ilocos Norte); *bangkók* (Zambales); *batúan* (Negros, Guimaras Island, Burias Island); *bilúkau* (Rizal, Bataan, Batangas, Camarines); *binúkau* (Laguna, Bataan); *buragrís* (Camarines); *kamangsi* (Tayabas); *harás* (Capiz); *kandís* (Palawan); *kanúmai*, *kulilém* (Cagayan); *maninilá* (Albay).

The fruits are yellowish, somewhat rounded, and 4 centimeters or more in diameter. They have a firm outer covering and contain a very acid pulp and several seeds. The fruit is eaten by the Filipinos with fish.

Garcinia binucao is a tree reaching a height of about 25 meters and a diameter of about 40 centimeters. The leaves are opposite, smooth, leathery, and from 5 to 12 centimeters or more in length. The flowers are small, red, and borne in small clusters.

This species is common and widely distributed throughout Luzon and the Visayan Islands. It is cultivated only at the Lamao Experiment Station.

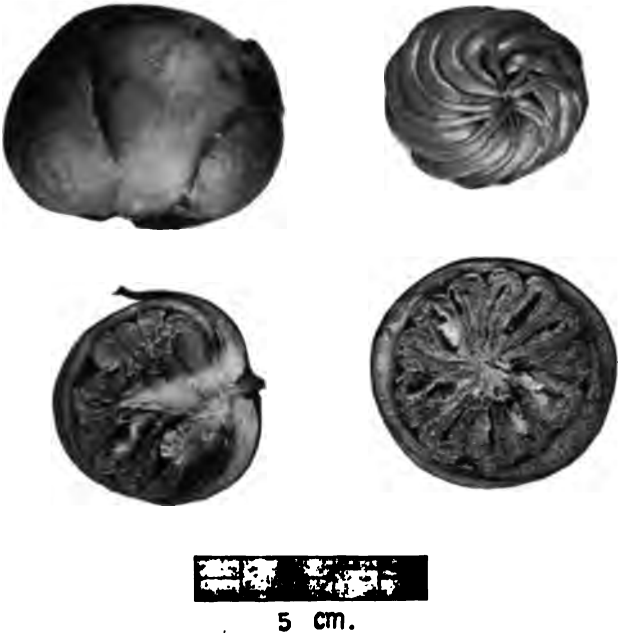

FIGURE 63. DILLENIA PHILIPPINENSIS (KATMON).

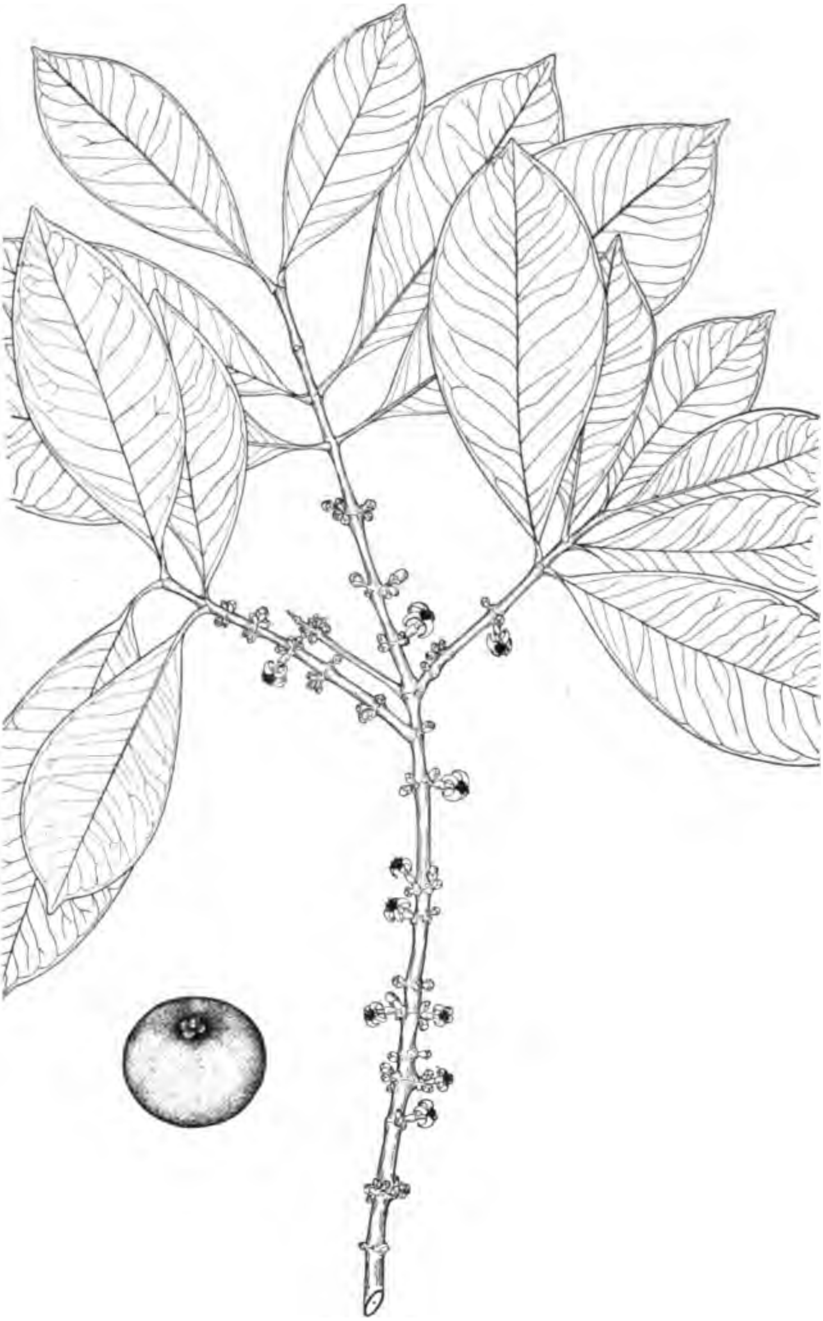

FIGURE 64. GARCINIA BINUCAO (BINUKAU). X½.

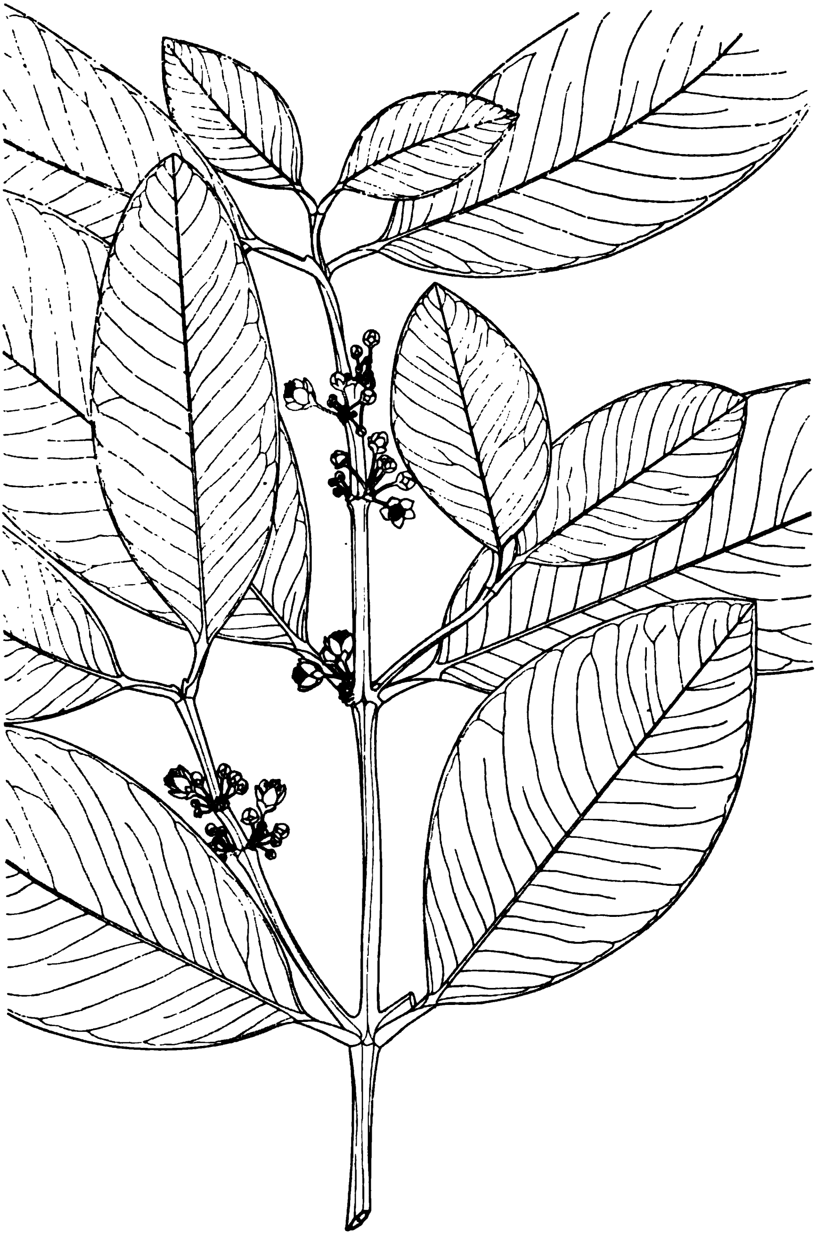

FIGURE 65. GARCINIA DULCIS (TAKLANG-ANAK). × ½.

GARCINIA DULCIS Kurz. (Fig. 65). TAKLÁNG-ANÁK.

Local names: *Alokó* (Isabela); *baniti* (Zambales); *bunég* (Cagayan, Ilocos Sur, Pangasinan); *gatásan* (Palawan, Camarines, Negros); *takláng-anák* (Rizal, Bataan).

The fruit is yellow, smooth, and about 5 to 7 centimeters in diameter. It has a firm outer covering, and a very acid, soft, juicy pulp. It is suitable for preserves.

According to Heyne,* the fruits are rarely seen in the markets of Batavia, but then in great quantities.

Garcinia dulcis is a tree reaching a height of about 15 meters and a diameter of about 30 centimeters. The leaves are opposite, smooth, leathery, somewhat oval in shape, and 12 to 20 centimeters or more in length. The flowers are white, over a centimeter in diameter, and borne in small rounded clusters.

This species is common and widely distributed from northern Luzon to the southern limits of the Philippines. It is not cultivated except at the Lamao Experiment Station.

GARCINIA MINDANAENSIS Merr. KARÍIS.

Local names: *Gatásan, karí-is* (Bukidnon).

The fruit is edible.

Garcinia mindanaensis is a tree reaching a height of about 10 meters and a diameter of about 15 centimeters. The leaves are opposite, pointed at both ends, 13 to 18 centimeters long, and 4 to 8 centimeters wide. The male flowers are red, and occur in axillary fascicles. The petals are four in number, and about 7 millimeters long.

This species has been reported only from Mindanao and Basilan.

GARCINIA RUBRA Merr. (Fig. 66). KAMANDÍIS.

Local names: *Kamandíis* (Laguna, Mindoro); *kamanitíis* (Mindoro); *kandíis* (Zamboanga).

The fruits are about 3 centimeters in diameter, somewhat rounded but flattened, yellowish to red, fleshy, and edible.

Garcinia rubra is a tree reaching a height of 10 meters and a diameter of 15 centimeters. The leaves are opposite, thin, pointed at both ends, and 6 to 12 centimeters in length. The flowers are small, borne in small, axillary clusters and are bright red.

This species is distributed from northern Luzon to northern Mindanao. It is not in cultivation.

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 3, page 264.

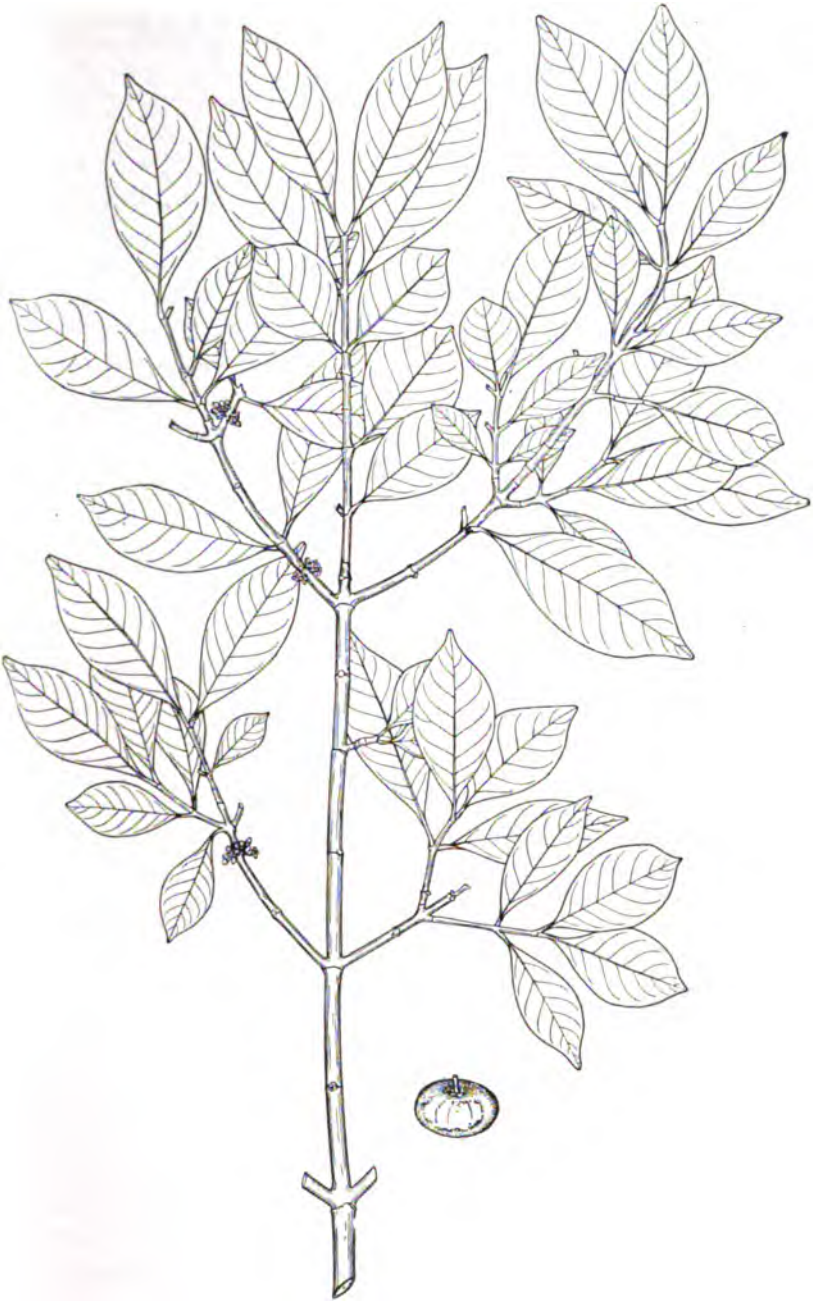

FIGURE 66. GARCINIA RUBRA (KAMANDIIS). ×½.

GARCINIA VENULOSA Choisy. (Fig. 67). GATÁSAN.

Local names: *Bilúkau* (Camarines, Bataan); *binúkau* (Laguna); *bunóg* (Palawan); *bunág* (Cagayan); *bunég* (Pangasinan); *gatásan* (Laguna, Tayabas); *kalokóg* (Tayabas); *katúri* (Cagayan, Isabela); *mangala* (Zamboanga); *pédis* (Pampanga); *péris* (Cavite, Batanes); *takláng-anák* (Laguna, Bataan, Mindoro).

The fruits are about 4 to 6 centimeters in diameter, somewhat rounded but flattened, and sour. The edible portion is surrounded by a rather hard rind and contains several flat seeds. The fruit is eaten with fish by Filipinos.

Garcinia venulosa is a tree reaching a height of about 15 meters and a diameter of about 40 centimeters. The leaves are opposite, leathery, smooth, and up to 20 centimeters or more in length. The flowers are fairly small, and borne in rather small, rounded clusters.

This species is very common and widely distributed throughout the Philippines. It is not cultivated.

GARCINIA VIDALII Merr. PÍRIS.

Local names: *Antol* (Mountain Prov.); *bilis* (Benguet); *bitanhól, bugalót* (Sibuyan); *bunúg* (Pangasinan); *katápang* (Butuan); *paláñge* (Leyte); *paláñgi* (Samar); *péres* or *píris* (Rizal).

The fruit is about 6 centimeters in diameter. It has a firm outer covering, several seeds, and a firm, acid, fleshy pulp with a pleasant flavor.

Garcinia vidalii is a tree reaching a height of 25 meters and a diameter of 90 centimeters. The leaves are opposite, smooth, leathery, oval, usually notched at the tip, and from 10 to 20 centimeters or more in length. The flowers are white, of medium size, and occur in clusters.

This species is distributed from the Mountain Province of Luzon to Mindanao. It is rarely cultivated.

Family FLACOURTIACEAE

Genus FLACOURTIA

FLACOURTIA RUKAM Zoll. et M. (Fig. 68).

Local names: *Agas-ás* (Dinagat Island); *amai-it* (Polillo); *bitoñgol* (Laguna); *kalamansánai, lalamasali* (Zambales); *kaluñga* (Benguet); *obiéng* (Pangasinan); *salabágin* (Cebu).

The fruits are small, violet colored, fleshy, subacid, and of good flavor.

According to Crevost and Lemarié,* in Indo-China this species

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* Cat. Prod. de l'Indo-Chine, page 195.

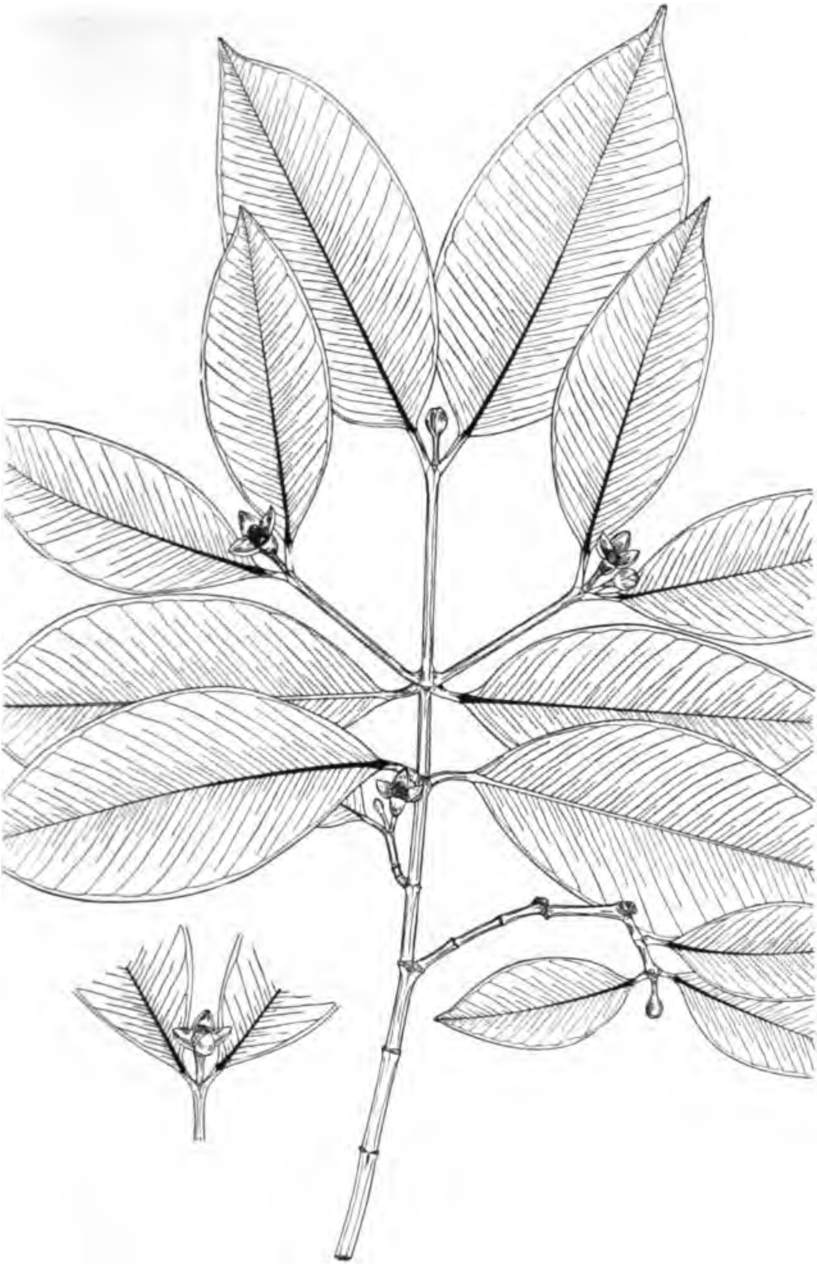


FIGURE 67. GARCINIA VENULOSA (GATASAN). ×½.

is cultivated for its berries, which are the size of large cherries, very sour, and good for pies.

Flacourtia rukam is a tree reaching a height of about 20 meters and a diameter of about 30 centimeters. The leaves are from 5 to 15 centimeters in length, the apex pointed, the base rounded or pointed. The young stems are very rough. The flowers are very small and occur in clusters in the axils of the leaves.

This species is distributed from Benguet to the southern limits of the Archipelago.

FLACOURTIA INDICA (Burm. f.) Merr. (Fig. 69).

Local names: *Bitoñgol* (Tarlac, Rizal); *bolóng* (Mindoro); *palutan* (Cagayan).

The fruit is rounded, fleshy, purple or nearly black, smooth, and 1 centimeter in diameter. The pulp is fleshy, edible, and has an agreeable flavor.

Flacourtia indica is a shrub or small tree reaching a height of 8 meters and a diameter of about 15 centimeters. This tree is armed with scattered, slender spines which are often 2 centimeters in length. The leaves are alternate, pointed at the base, and rounded at the tip. The edges of the leaves are toothed with rounded lobes. The flowers are white, occur singly or in pairs in the axils of the leaves or terminate short branchlets. They are about 5 millimeters in diameter.

This species has been reported from the following provinces: Cagayan, Isabela, Tarlac, Zambales, Bataan, Rizal, and Mindoro.

FLACOURTIA EUPHLEBIA Merr. LANAGON.

Local name: *Lanagon* (Mindanao).

The fruits occur singly or in small clusters in the leaf axils, are 1 to 1.25 centimeters in diameter, and edible.

Flacourtia euphlebia is a tree-like shrub, about 5 meters in height, with a trunk about 10 centimeters in diameter. The leaves are alternate, the larger ones about 25 centimeters long by 10 centimeters wide. The margins are finely or coarsely toothed.

This species is reported only from Mindanao and is apparently rare.

Genus PANGIUM

PANGIUM EDULE Reinw. (Fig. 70). PÁÑGI.

Local names: *Páñgi* (Negros, Samar, Iloilo, Camarines, Albay, Sorsogon, Cebu, Palawan); *malapañgi* (Davao).

The fruit is large, brown, and contains several seeds embedded in a yellowish, edible pulp. The fresh seeds are poisonous, but are rendered edible by steeping in water.

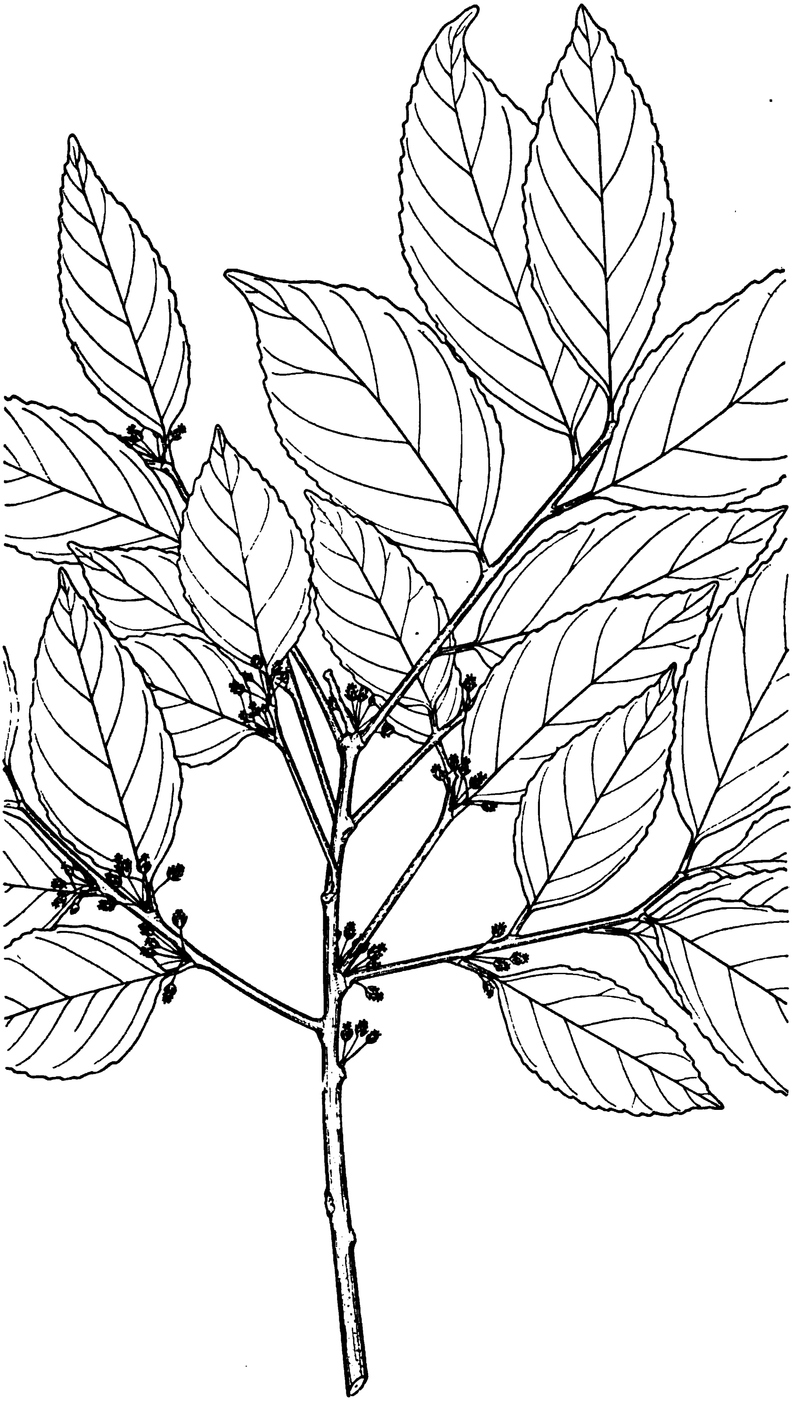


FIGURE 68. FLACOURTIA RUKAM. ×½.

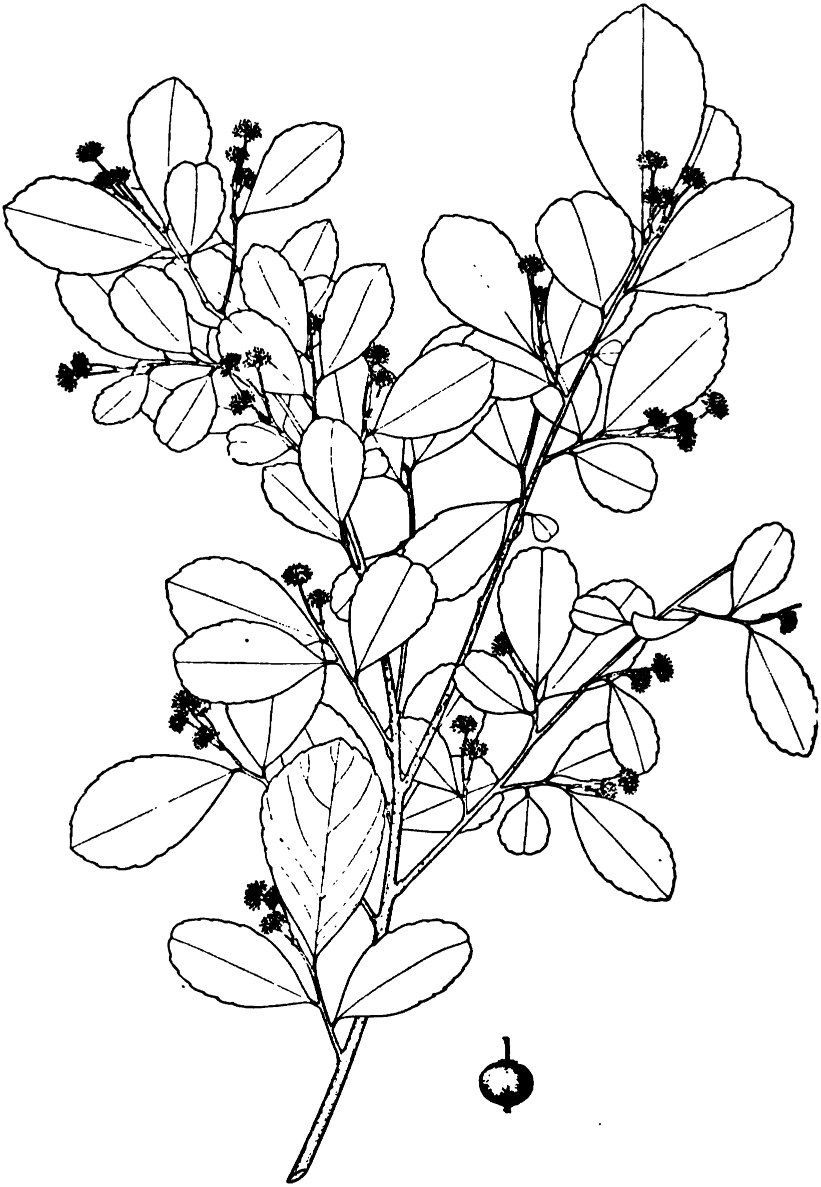


FIGURE 69. FLACOURTIA SEPIARIA. ×½.

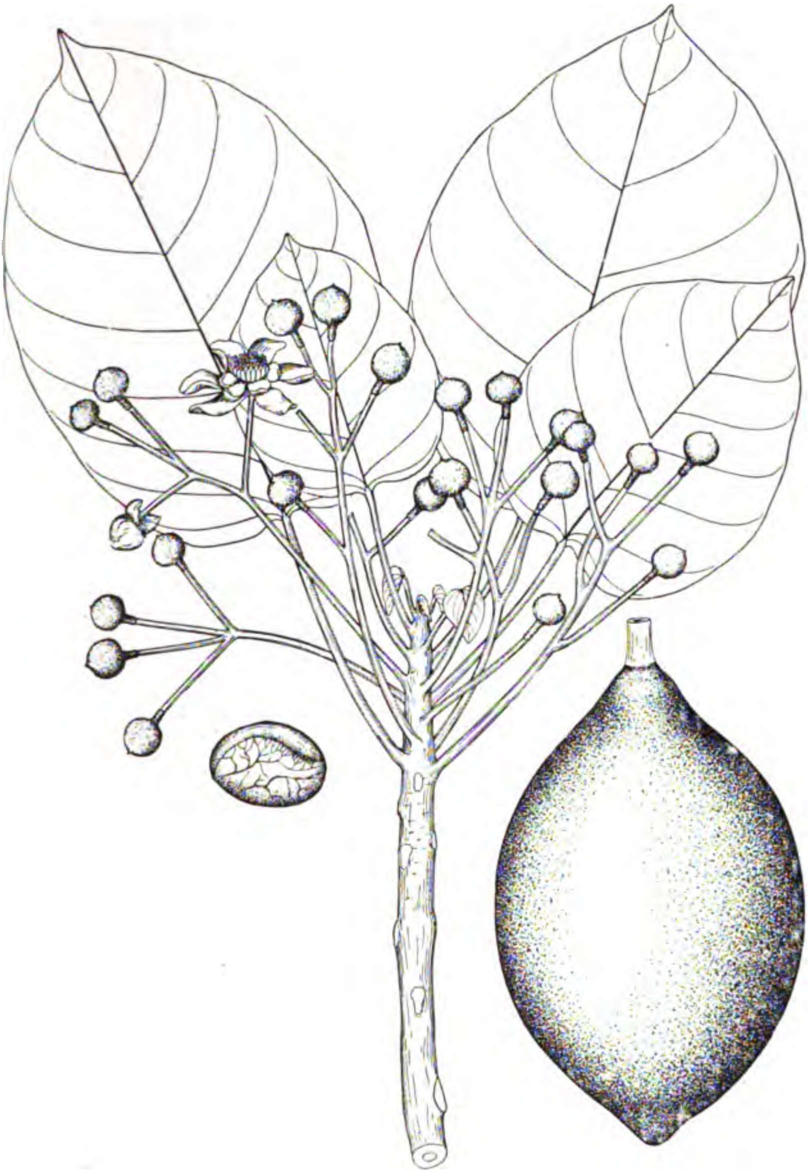


FIGURE 70. PANGIUM EDULE (PAÑGI). ×⅔.

Pangium edule is a tree reaching a height of about 25 meters and a diameter of about 50 centimeters. The leaves are very large, smooth, entire or lobed, pointed at the apex, and rounded or heart-shaped at the base. The flowers are yellowish green, have a faint odor, and are borne on compound inflorescences.

This species is distributed from southern Luzon to southern Mindanao.

Family BEGONIACEAE

Genus BEGONIA

BEGONIA Spp.

The acid stems of various species of *Begonia* are eaten as a flavoring with meat and fish.

Family ELAEAGNACEAE

Genus ELAEAGNUS

ELAEAGNUS PHILIPPENSIS Perr. ALIÑGÁRO.

Local names: *Aliñgáro* (Rizal, Cavite, Batangas, Laguna); *banaken* (Batangas); *kamagsá* (Laguna); *liñgaro* (Rizal); *mala-ímus* (Negros).

The fruit of this plant when ripe is sweet and edible.

Elaeagnus philippensis is a shrubby vine with small, alternate leaves, which are pointed at both ends. The lower surfaces are thickly dotted with scales. The flowers are small and inconspicuous.

This species is distributed throughout the Philippines and is common in the northern provinces.

Family SONNERATIACEAE

Genus SONNERATIA

SONNERATIA ALBA Sm. PEDADÁ.

A description of this species and its local names are given in the bulletin on mangrove swamps.

The fruit is slightly acid, is used as an article of food, and also for making vinegar.

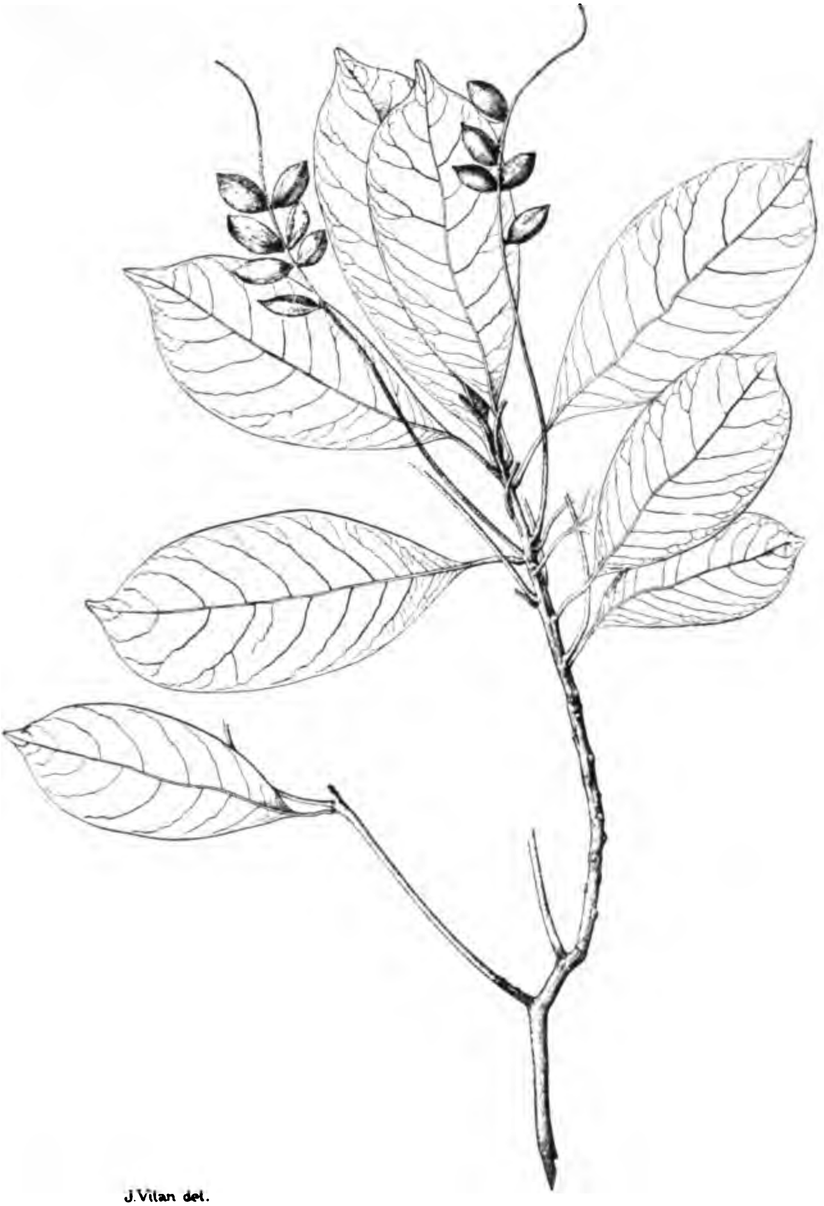
Family COMBRETACEAE

Genus TERMINALIA

TERMINALIA CATAPPA L. TALÍSAI.

A description and figure of this species and its local names are given in the bulletin on resins, gums, and oils.

The fruit is 3 to 6 centimeters long, somewhat flattened, ellipsoid in outline, prominently keeled along the sides, and contains an edible seed of good flavor. It is, however, difficult to extract the seed from the fruit.



J. Vilan del.

FIGURE 71. TERMINALIA EDULIS (KALUMPIT).

TERMINALIA EDULIS Blanco. (Fig. 71). KALUMPÍT.

Local names: *Alupí, kalupé, kalupí, kalusít* (Cagayan); *anagép* (Ilocos Sur); *bágu* (Butuan); *báho* (Palawan); *balisáyin, malagábi* (Mindoro); *baraies* (Palawan); *basi* (Nueva Ecija); *bisal* (Bulacan); *dalínsi* (Tayabas, Laguna); *disi* (Nueva Vizcaya); *gayumáhin* (Zambales); *gisit* (Nueva Vizcaya); *kalamansánai* (Rizal); *kalaútit* (Nueva Vizcaya, Ilocos Sur, Benguet, Pangasinan, Cagayan); *kalomágon, kalománog* or *kalumáñgon* (Masbate, Samar, Camarines, Sorsogon); *kalumpít* (Mindoro, Zambales, Tarlac, Bulacan, Laguna, Masbate, Zamboanga, Bataan, Tayabas, Rizal, Cagayan, Camarines); *kalupí, kalurig* (Cagayan); *kalusí, kalusít* (Ilocos Sur, Cagayan); *kamaris* (Palawan); *kayumayen* (Zamboanga); *kotmók* (Camarines); *magtalísai* (Sorsogon, Masbate, Bisayas); *sákat* (Laguna); *sáket* (Pangasinan); *tako* (Northern Luzon); *talísai* (Sulu); *tañgál* (Camarines); *taya-táya* (Guimaras Island).

The fruits are about 3 centimeters wide, smooth, dark red, fleshy, and acid, and should make a good preserve.

Terminalia edulis is a tree reaching a height of about 35 meters and a diameter of about a meter. The leaves are from 6 to 15 centimeters in length, smooth, and pointed at both ends. The flowers are small, yellowish white, and are borne on slender spikes which grow from the axils of the leaves.

This species is very common and widely distributed in the forests from northern Luzon to southern Mindanao. It is not known to be cultivated except at the Lamao Experiment Station.

Family MYRTACEAE

Genus EUGENIA

EUGENIA AHERNIANA C. B. Rob. TUL-ÁNAN.

Local names: *Hañgós* (Surigao); *lusunan* (Zamboanga); *lakkáñgan* (Cagayan); *magkonó, sambonotan, tul-ánan* (Samar); *malabayábas* (Laguna); *rukrukso* (Cagayan).

The fruits are rounded, about 2.5 centimeters in diameter, yellow, and edible.

Eugenia aherniana is a tree reaching a height of about 20 meters and a diameter of about 45 centimeters. The leaves are opposite, smooth, oval, somewhat pointed at both ends, and from 6 to 12 centimeters in length. The flowers occur singly in clusters in the axils of the leaves, including those of the terminal and fallen leaves. They are white, fragrant, and about 1.5 centimeters in breadth.

This species is distributed from northern Luzon to southern Mindanao. It is not in cultivation.

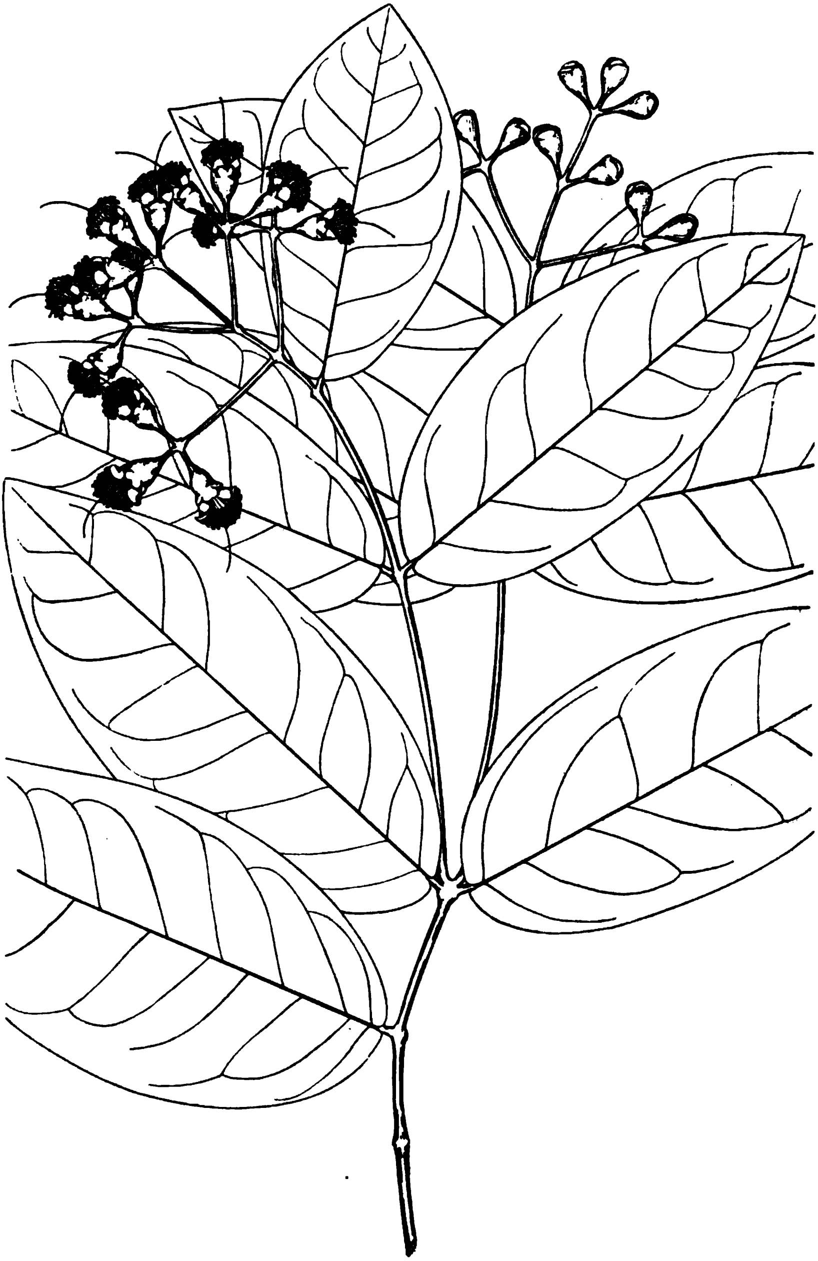


FIGURE 72. EUGENIA CALUBCOB (KALUBKUB). ×½.

EUGENIA AQUEA Burm. f. TAMBÍS.

Local names: *Marabayábas, tambís* (Samar).

The fruits are edible.

Eugenia aquea is a tree reaching a height of 30 meters and a diameter of about 70 centimeters. The leaves are smooth, pointed at both ends, and from 5 to 15 centimeters in length.

This species is found in Samar.

EUGENIA CALUBCOB C. B. Rob. (Fig. 72). KALUBKÚB.

Local names: *Adáng, andang* (Isabela); *balanga, kaupkúp, tuói* (Mindoro); *barabák* (Ilocos Sur, Union); *kalogkóg* (Nueva Ecija, Rizal, Tayabas, Samar); *kalubkúb* (Laguna, Rizal, Batangas, Tayabas); *karokób* (Camarines); *kayokóg, tampói* (Tayabas); *kupkúp* (Pampanga); *lambug* (Agusan); *makópa* (Laguna); *malaigang, tambís* (Negros Occidental); *malakópa* (Laguna, Negros Occidental); *malarúhat* (Nueva Ecija, Mindoro); *panglumbóien* (Isabela, Tarlac); *tampói, tampúti* (Bulacan, Tayabas).

The fruits are 4 to 5 centimeters long, greenish, and edible, with a good flavor.

Eugenia calubcob is a tree reaching a height of about 25 meters and a diameter of about 90 centimeters. The leaves are opposite, smooth, pointed at the apex, and rounded or heart-shaped at the base. The petioles are short. The flowers are white, 3 to 4 centimeters in diameter, and borne on compound inflorescences with few to many flowers.

This species is very common and widely distributed in the forests of the Philippines from the Batanes Islands to northern Mindanao. It is rarely cultivated.

EUGENIA CUMINI (Linn.) Merr. (*E. jambolana* Lam.) DÚHAT.

Local names: *Dúhat* (Nueva Ecija, Tarlac, Pampanga, Zambales, Bataan, Rizal, Manila, Laguna, Batangas, Tayabas, Mindoro, Negros, Cebu, Palawan); *longbói* (Cagayan, Abra, Ilocos Sur, Union); *lumbói* (Ilocos Norte, Bataan, Tarlac, Rizal, Pampanga, Camarines, Guimaras Island, Cebu).

The fruit is oval or elliptical, dark purple or nearly black, 1.5 to 2 centimeters long, fleshy, and contains a single large seed. When fully ripe the flavor is very agreeable, somewhat like that of a cherry, but more astringent. Duhat makes a delicious fruit ice. This fruit is a favorite with the Filipinos.

Eugenia cumini is a tree 4 to 15 meters in height. The leaves are opposite, smooth, shiny, leathery, and somewhat oval in shape. The flowers are pink or nearly white, and occur in con-

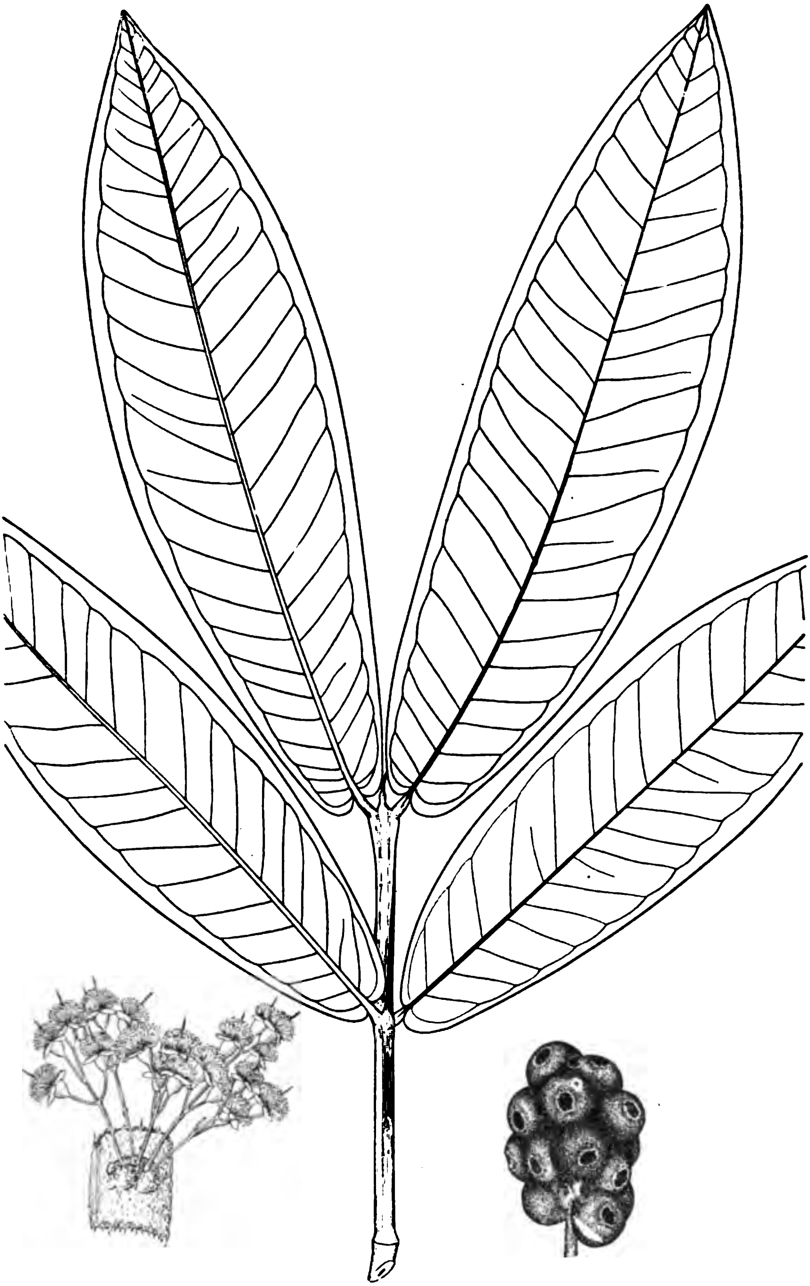


FIGURE 73. EUGENIA CURRANII (LIPOTE). ×⅔.

siderable numbers on compound inflorescences which are mostly below the leaves.

This species is apparently introduced in the Philippines, but is common and widely distributed in open places and second-growth forests. It is one of the most numerous trees in the early stages of the invasion of grass areas by second-growth forests.

EUGENIA CURRANII C. B. Rob. (Fig. 73). LIPÓTE.

Local name: *Égot* or *ígot* (Samar); *lipóte* (Laguna).

The fruit is rather small, but edible.

Eugenia curranii is a tree reaching a height of about 15 meters and a diameter of about 30 centimeters. The small branches are distinctly four-angled and more or less swollen at the nodes. The leaves are opposite, smooth, pointed at the apex, somewhat heart-shaped at the base, 20 to 25 centimeters in length, and 6 to 8 centimeters wide. The flowers are white, over 1.5 centimeters in width, and occur in clusters on the trunks and branches.

This species has been reported only from Laguna and Samar. It is not cultivated.

EUGENIA MANANQUIL Blanco. (Fig. 74). MANANGKÍL.

Local names: *Ansa* (Pangasinan); *babá* (Bontoc); *bagabag* (Pampanga); *bua-búa, muñgilkíl* (Mindoro); *bungkúlan, malarúhat* (Laguna); *dambohála* (Cavite, Batangas); *gorong-góng* (Isabela); *kagokó* (Lanao, Leyte); *kagukú, tambís, tambí, lugis, kagukúg* (Cotabato); *malahágis* (Sorsogon); *malaigang* (Negros); *marabayábas* (Cagayan); *midbíd, makaásim* (Tayabas); *modbód, mitbíd* (Camarines); *mitbít* (Davao); *panglongbóien, kopakópa* (Ilocos Sur); *pasóso* (Rizal); *tañgus* (Agusan).

The fruits are borne in large numbers, are about 4 centimeters long, ovoid, red, fleshy, acid, and of good flavor.

Eugenia mananquil is a tree reaching a height of about 30 meters and a diameter of about 120 centimeters. The leaves are opposite, smooth, pointed at both ends, and from 6 to 12 centimeters in length or longer. The flowers are pink and yellowish white, fragrant, about 1.5 centimeters in diameter, and grow in clusters on the trunks and large branches.

This species is very common and widely distributed in the forests of the Philippines from the northern part of Luzon to the Sulu Archipelago.

EUGENIA POLYCEPHALOIDES C. B. Rob. MAIGÁNG.

Local names: *Bali’gáng* (Camarines, Albay); *balasugan, magtalulóng* (Cagayan); *ígot* (Samar); *lipóte* (Laguna); *lipúte, piláuai* (Tayabas); *maigáng* (Leyte).

The fruit is rounded, a little more than a centimeter in diameter, and has a color and flavor similar to that of the common

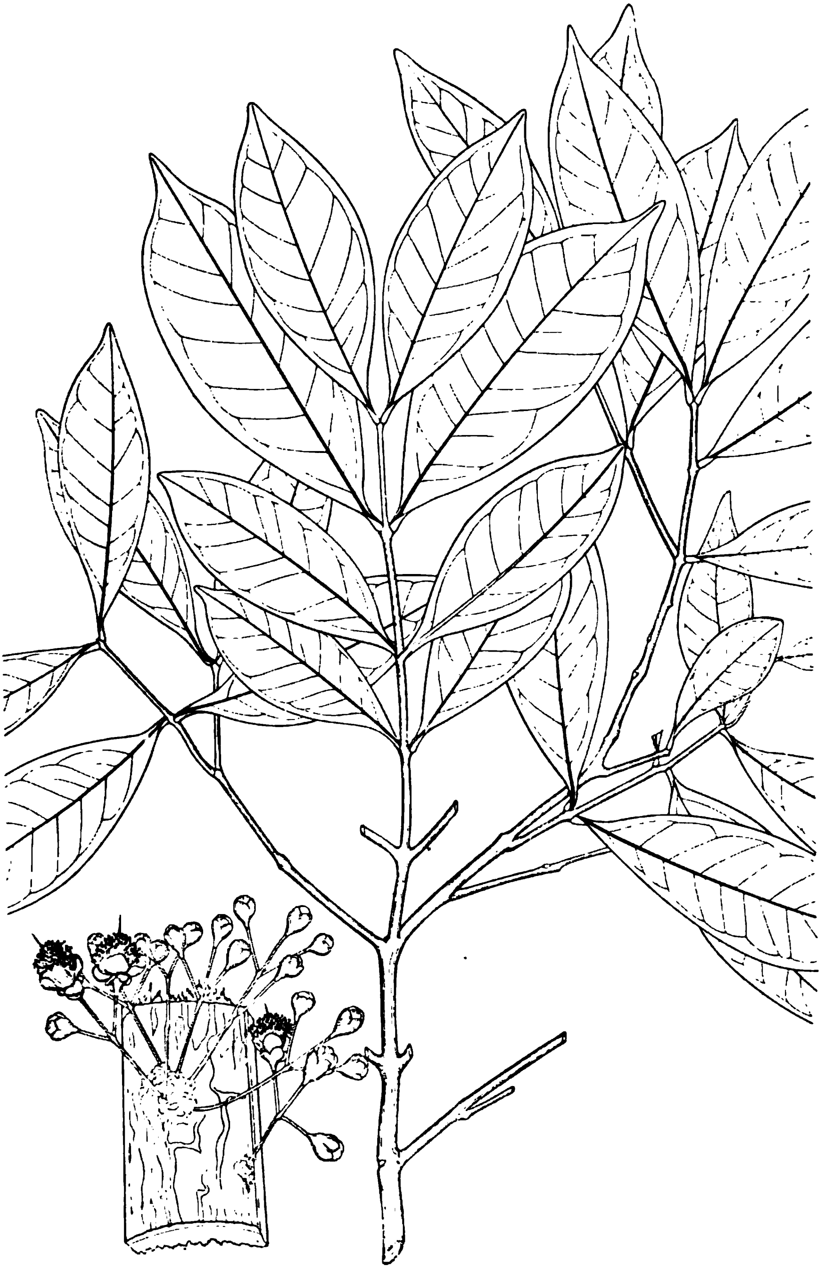


FIGURE 74. EUGENIA MANANQUIL (MANANGKIL). ×½.

duhat (*Eugenia cumini*), but is less sweet and juicy. It makes a delicious, tart jelly.

Eugenia polycephaloides is a tree reaching a height of about 25 meters and a diameter of about 90 centimeters. The small branches are four-angled. The leaves are opposite, smooth, pointed at the apex, somewhat heart-shaped at the base, and 12 to 20 centimeters or more in length. The flowers are white, fragrant, and borne in rather large clusters on compound inflorescences which occur below the leaves.

This species is distributed from northern Luzon to southern Mindanao. It is not cultivated.

EUGENIA XANTHOPHYLLA C. B. Rob. (Fig. 75). MALATAMPÚI.

Local names: *Apníg, lapiníg* (Sorsogon); *balakbák, baloklók* (Zambales); *barakbák* (Ilocos Sur, Nueva Ecija); *bislót, tampói-gúbat* (Rizal); *kayogpóg, kayokós, kayugkók, malayambo* (Tayabas); *malatampúi* (Negros Occidental); *panglumbúyen* (Pangasinan); *tampói* or *tampúi* (Mindoro).

The fruits are about 2 or 2.5 centimeters in diameter, and edible.

Eugenia xanthophylla is a tree reaching a height of about 20 meters and a diameter of about 50 centimeters. The leaves are opposite, smooth, pointed at both ends, and from 7 to 15 centimeters or more in length. The flowers are white.

This species is widely distributed in the forests of Luzon and the Visayan Islands.

Genus PSIDIUM

PSIDIUM GUAJAVA L. (Fig. 76). GUAVA OR BAYÁBAS.

Local names: *Bayábas* (Manila, Nueva Ecija, Laguna, Cagayan, Abra, Bulacan, Union, Benguet, Bataan, Polillo, Mindoro, Cebu, Tayabas, Tarlac, Pampanga, Leyte); *bayáuas* (Camarines); *guava* (Cagayan); *guayábas* (Laguna, Bataan); *guyábas* (Bontoc).

The fruit is rounded, 4 to 5 centimeters long, and is green, turning yellow when ripe. The outer covering is firm and encloses a pink or nearly white, aromatic, edible pulp in which very numerous seeds are embedded. The fruit is a favorite with the Filipinos and is extensively used in the manufacture of jellies.

Psidium guajava is a small tree reaching a height of about 8 meters. The branches are four-angled. The leaves are opposite, somewhat hairy, oval, and usually pointed at both ends. The flowers are white, showy, and borne in panicles of from one to three flowers. The petals are 1.5 to 2 centimeters in length.

This species is very common and widely distributed in open places and second-growth forests in the lowlands throughout the Archipelago, and is also cultivated.

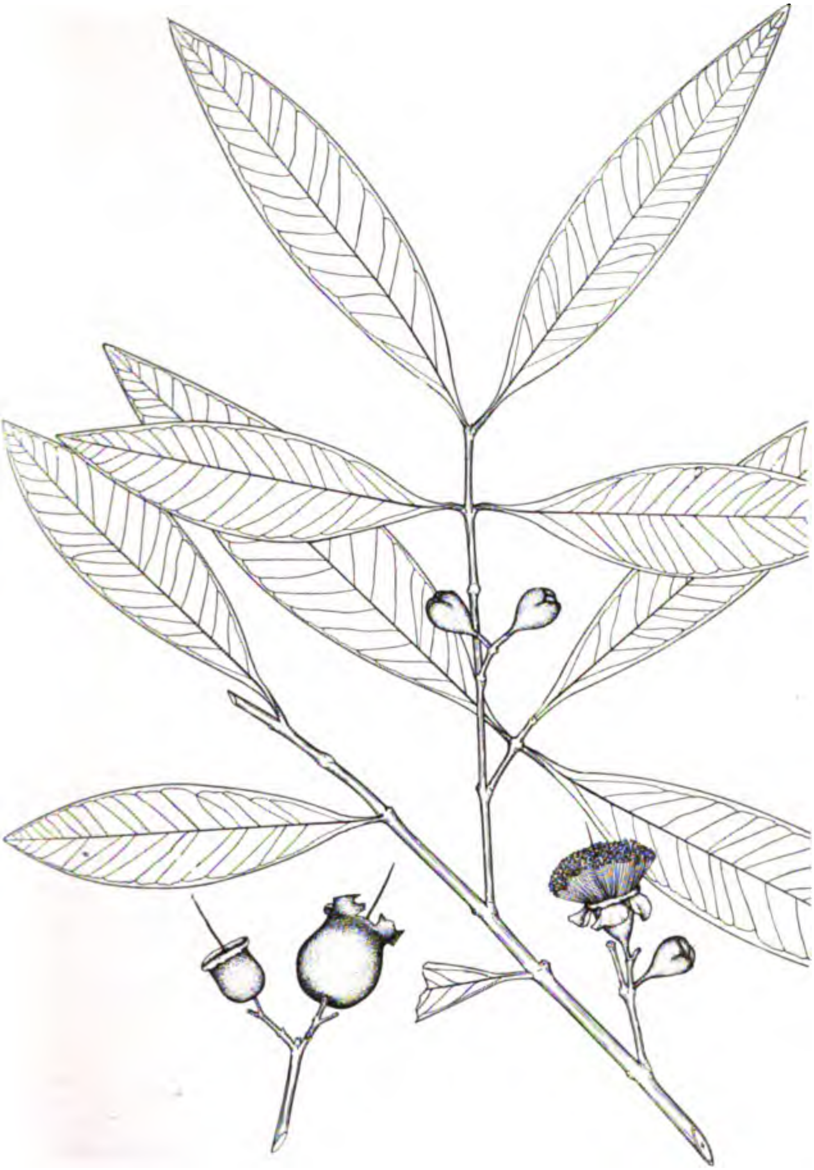


FIGURE 75. EUGENIA XANTHOPHYLLA (MALATAMPUI). ×⅓.

Genus RHODOMYRTUS

RHODOMYRTUS TOMENTOSA Hassk.

The fruit is surrounded by a small pulp which is edible.

Rhodomyrtus tomentosa is a shrub. The leaves are opposite, 3 to 7 centimeters in length, leathery, pointed at the base, rounded or slightly pointed at the tip, and with the under surfaces hairy.

This species is found only in northern Luzon and the Babuyanes Islands.

Family ERICACEAE

Genus VACCINIUM

VACCINIUM MYRTOIDES (Blume) Miq. (Fig. 77).

Local name: *Gatmo* (Benguet).

The fruit is a blueberry very similar to the blueberries of America. It has an excellent taste and makes fine preserves and pies.

Vaccinium myrtoides is a shrub. The leaves are alternate. leathery, 2 to 2.5 centimeters in length, pointed at the tip, and rounded or pointed at the base. The flowers are small, and whitish or purplish.

This species is distributed from Luzon to Mindanao and is common in Benguet, Luzon.

VACCINIUM WHITFORDII Merr. KATMO.

Local names: *Fafalong* (Bontoc); *katmo* (Benguet); *lusong* (Lepanto); *parukapol* (Neva Ecija).

The fruits are produced singly in the axils of the leaves. They are small, black, juicy, subacid, sweet, and of good quality.

Vaccinium whitfordii is a shrub or small tree 1 to 5 meters in height or taller. The leaves are about 1.5 centimeters in length and 5 millimeters wide. The flowers are small and red.

This species is found in the northern part of Luzon, particularly in the Mountain Province, and also in Mindoro, Leyte, and Occidental Negros. It is not cultivated.

Family MYRSINACEAE

Genus ARDISIA

ARDISIA BOISSIERI A. DC. TAGPÓ.

Local names: *Apiot* (Agusan); *kanai* (Palawan); *katagpó* (Batangas); *katatbum, pataktól* (Pampanga); *kolagpúng-pulá* (Zambales); *lipúting-*

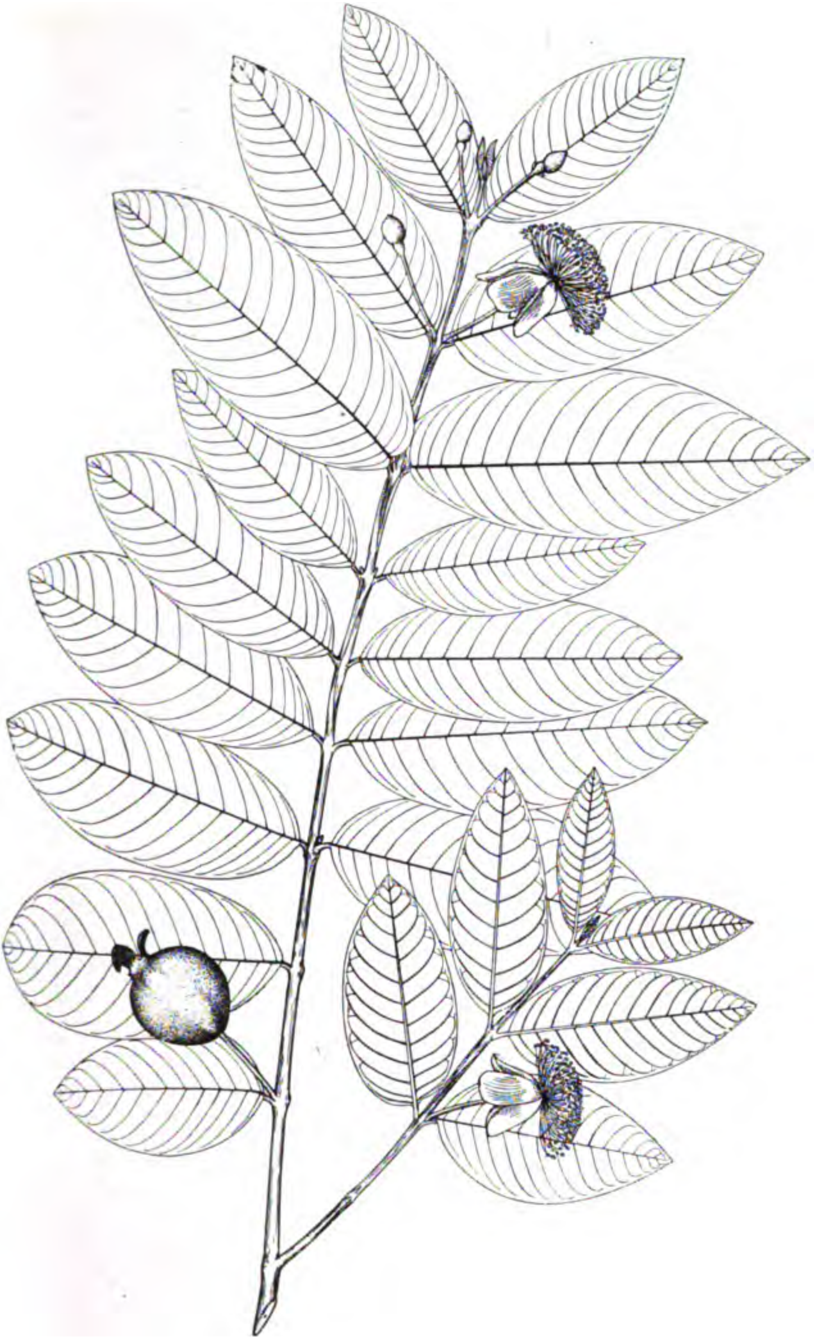


FIGURE 76. PSIDIUM GUAJAVA (GUAVA OR BAYABAS). ×½.

gúbat, malayambo, pingit (Tayabas); *malaranúm* (Nueva Ecija); *mulang* (Cagayan); *oksor* (Ilocos Norte); *tagpúng-pulá* (Rizal); *tagpó* (Bulacan, Laguna); *tukál* (Laguna).

The flowers and fruits are cooked as a flavoring with fish.

Ardisia boissieri is a small tree reaching a height of about 10 meters and a diameter of 15 centimeters. The leaves are alternate, rather slender, and pointed at both ends. The flowers are borne on compound, terminal or lateral inflorescences and are about a centimeter in length. They are white or pink, and fragrant. The stalks are about 3 centimeters long. The fruits are dark blue or purple, rounded, and less than a centimeter in diameter.

This species is very common and is distributed from Luzon to Mindanao.

Genus EMBELIA

EMBELIA PHILIPPINENSIS A. DC.

Local names: *Binurok* (Iloko); *bisalak, bisudak* (Igorot in Benguet); *dekai-dekaiang* (Bukidnon); *palongpóng* (Iloko); *pongpóng* (Igorot in Bontoc).

The acid leaves are eaten with fish.

Embelia philippinensis is a woody vine, the old stems of which are spiny. The leaves are alternate, leathery, smooth, and from 7 to 14 centimeters in length. The flowers are small, whitish, and occur in considerable numbers on compound inflorescences.

This species is distributed from northern Luzon to southern Mindanao.

Family SAPOTACEAE

Genus BASSIA

BASSIA OBOVATIFOLIA Merr.

Local name: *Maniknik* (Camarines).

The fruit of this species resembles the chico (*Achras sapota* L.) but it is about twice as large, and has a light-colored skin, which is thin and rough. The flesh is like that of the chico in color, consistency and flavor; while the seeds are also similar.

Bassia obovatifolia is a tree about 20 meters in height. The leaves are leathery, rounded at the tip, pointed at the base, larger near the tip than near the base, 7 to 12 centimeters long, and 4 to 6.5 centimeters wide.

This species has been reported only from Camarines.

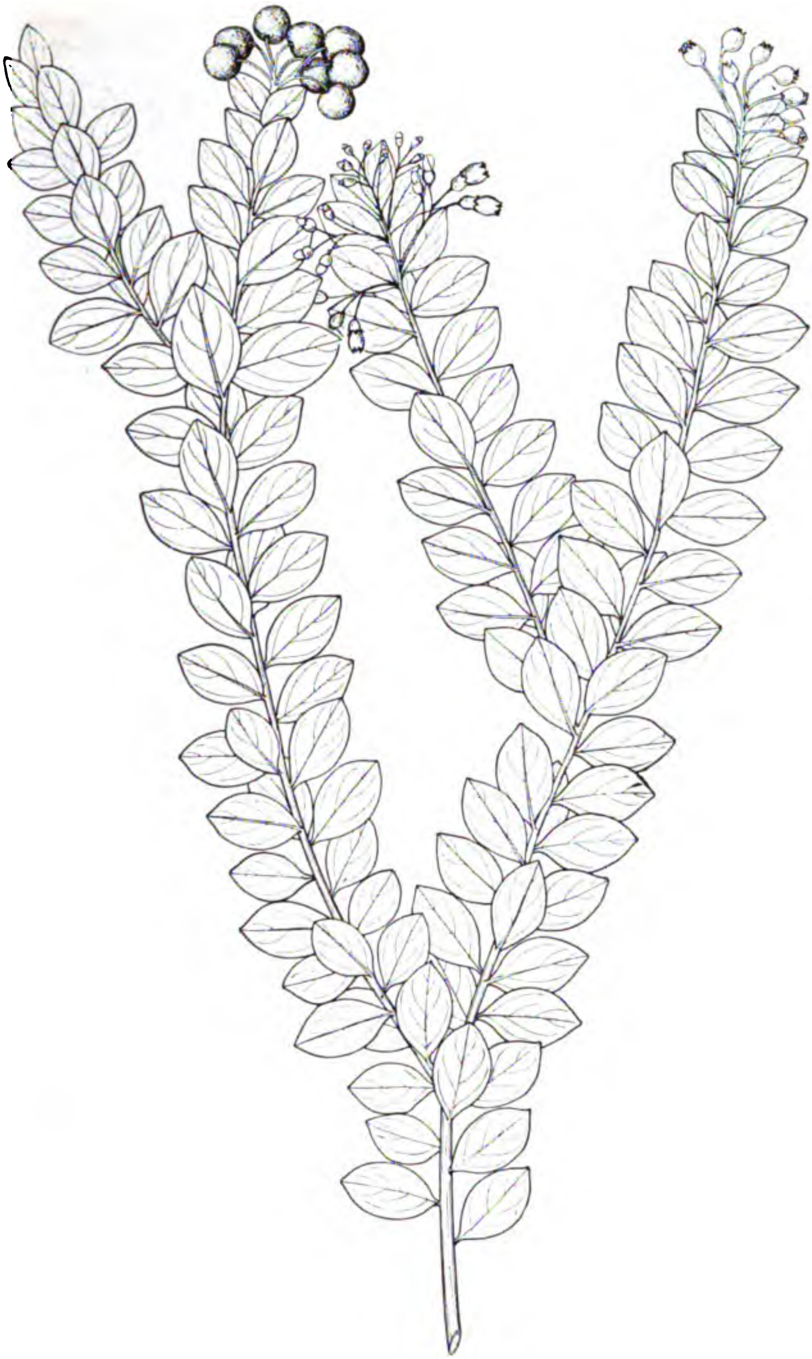


FIGURE 77. VACCINIUM MYRTOIDES. $\times\frac{2}{3}$

Genus MIMUSOPS

MIMUSOPS PARVIFOLIA R. Br. (Fig. 78). BANSALÁGIN.

Local names: *Bansalágin* (Tayabas, Masbate, Palawan, Mindoro, Cavite, Batangas, Camarines, Union, Ticao Island, Bataan, Cotabato, Zamboanga); *bansaiágon* (Sibuyan, Masbate, Negros); *gatásan* (Nueva Ecija); *gasátan-muláto* (Ilocos Sur); *liñgo-liñgo, ligayán, bansalágin-mujér, uláyan* (Zamboanga); *pagpágan* (Cagayan, Palaui Island); *pappágan* (Cagayan); *pásak* (Nueva Ecija, Tarlac, Pampanga); *tagátoi* (Bulacan); *talipópo* (Culion).

The fruit is oval, about 3 centimeters long, and reddish or yellowish. It has a firm outer covering, and contains a single seed surrounded by a fleshy, aromatic, edible pulp.

Mimusops parvifolia is a tree reaching a height of about 25 meters and a diameter of about 90 centimeters. The leaves are alternate, smooth, pointed at both ends, and from 4 to 10 centimeters in length. The flowers are rather small, white, and fragrant. The inner bark is red and contains a sticky, milky sap.

This species is very common and widely distributed in the forests from northern Luzon to the southern limits of the Archipelago. It is rarely cultivated.

Genus PALAQUIUM

PALAQUIUM PHILIPPENSE C. B. Rob. (Fig. 79). MALAKMÁLAK.

Local names: *Agás, alaká, manimparog* (Mindoro); *alakáak* (Cavite, Rizal, Batangas, Laguna, Bataan, Tayabas, Mindoro, Pampanga); *apaka-paká, bitók* (Isabela); *araká* (Cagayan); *banití* (Bataan); *dulitan-taklóban, malapútat* (Tayabas); *malakmálak* (Zambales); *malasapúti* (Pampanga); *manogtalísai* (Cagayan); *náto-pulá* (Albay); *pakáran, palak-pálak* (Bataan, Pangasinan, Pampanga, Bulacan, Tarlac, Zambales).

The fruit is oval, about 3 or 4 centimeters or more in length, contains a single seed, and is edible.

Palaquium philippense is a tree reaching a height of about 25 meters and a diameter of about 80 centimeters. The leaves are usually 16 centimeters or more in length. The lower surfaces are very striking, being velvety and russet colored. The flowers are about 1.5 centimeters in length, and are borne on long stalks in small clusters. The corolla is white, the calyx brown and velvety.

This species is very common and widely distributed from northern Luzon to southern Mindanao. It is cultivated only at the Lamao Experiment Station.

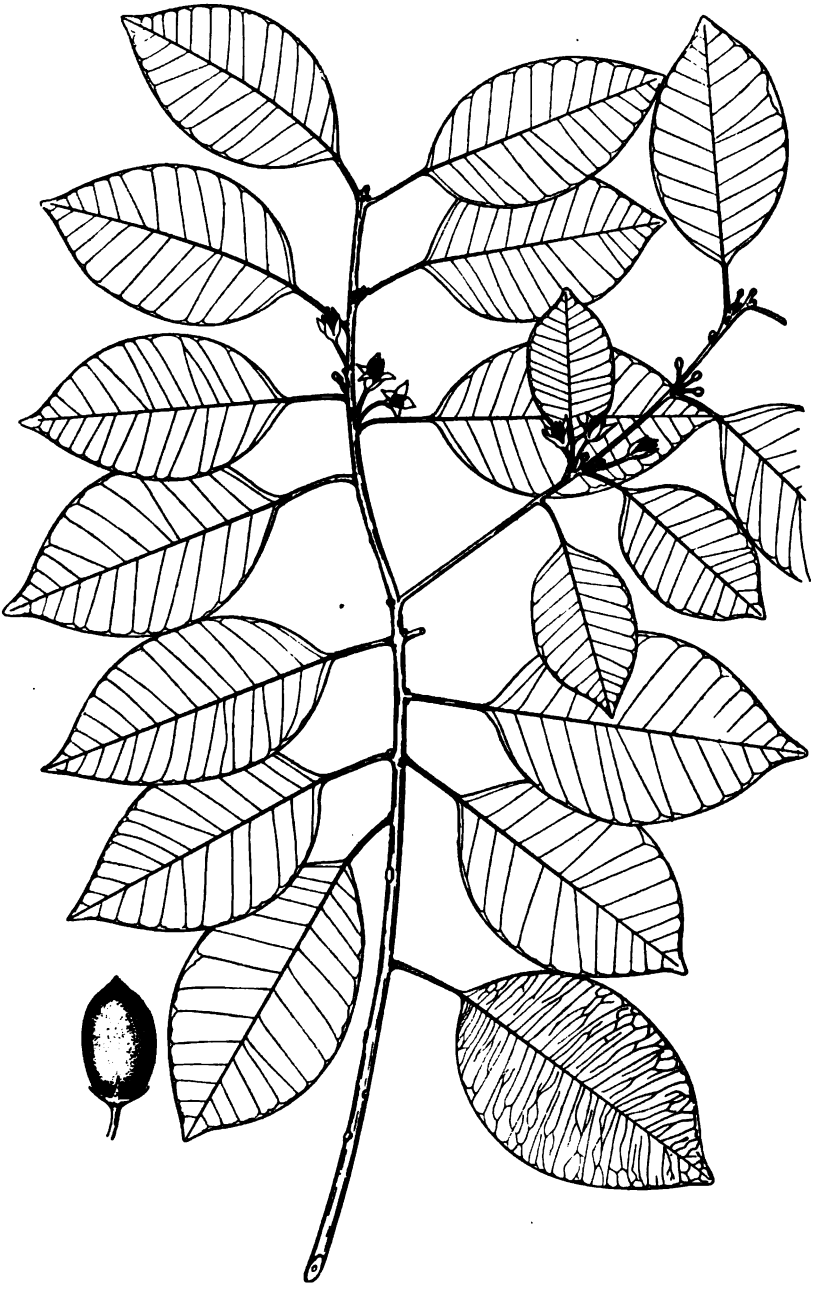


FIGURE 78. MIMUSOPS PARVIFOLIA (BANSALAGIN). ×½.

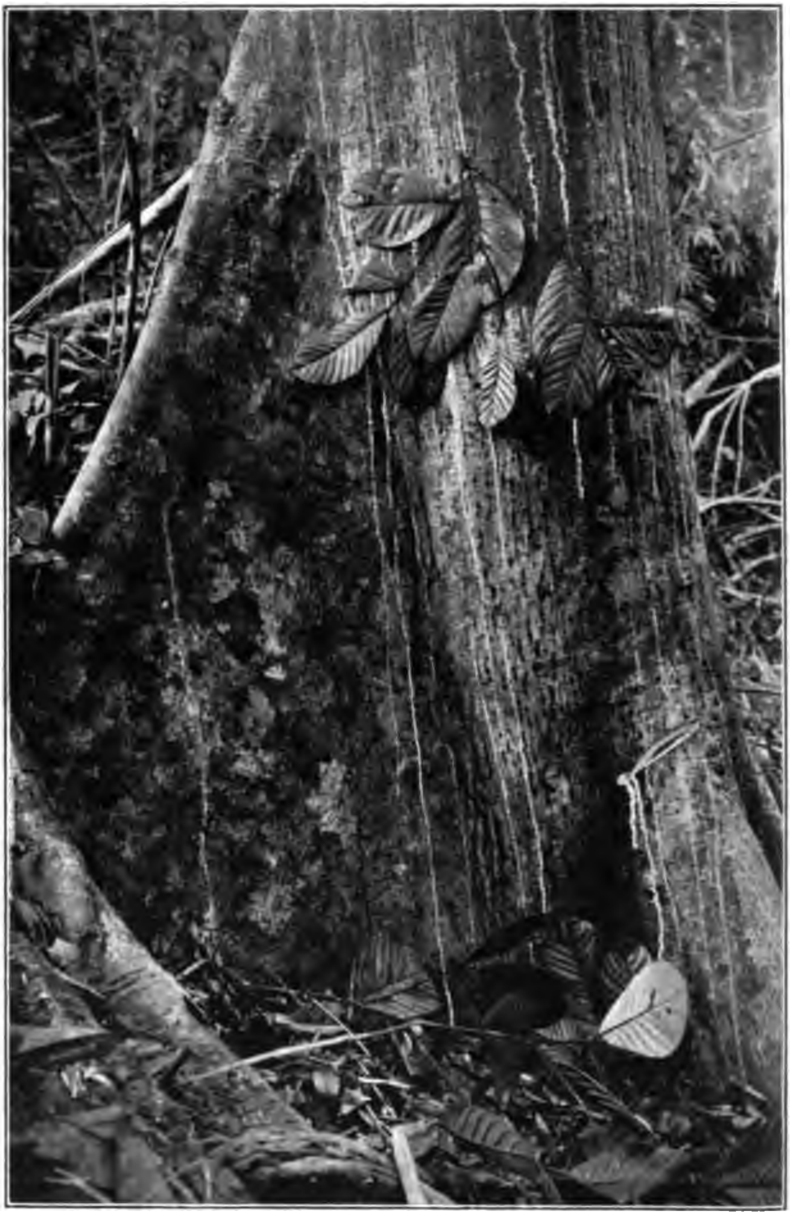


FIGURE 79. PALAQUIUM PHILIPPENSE (MALAKMALAK).

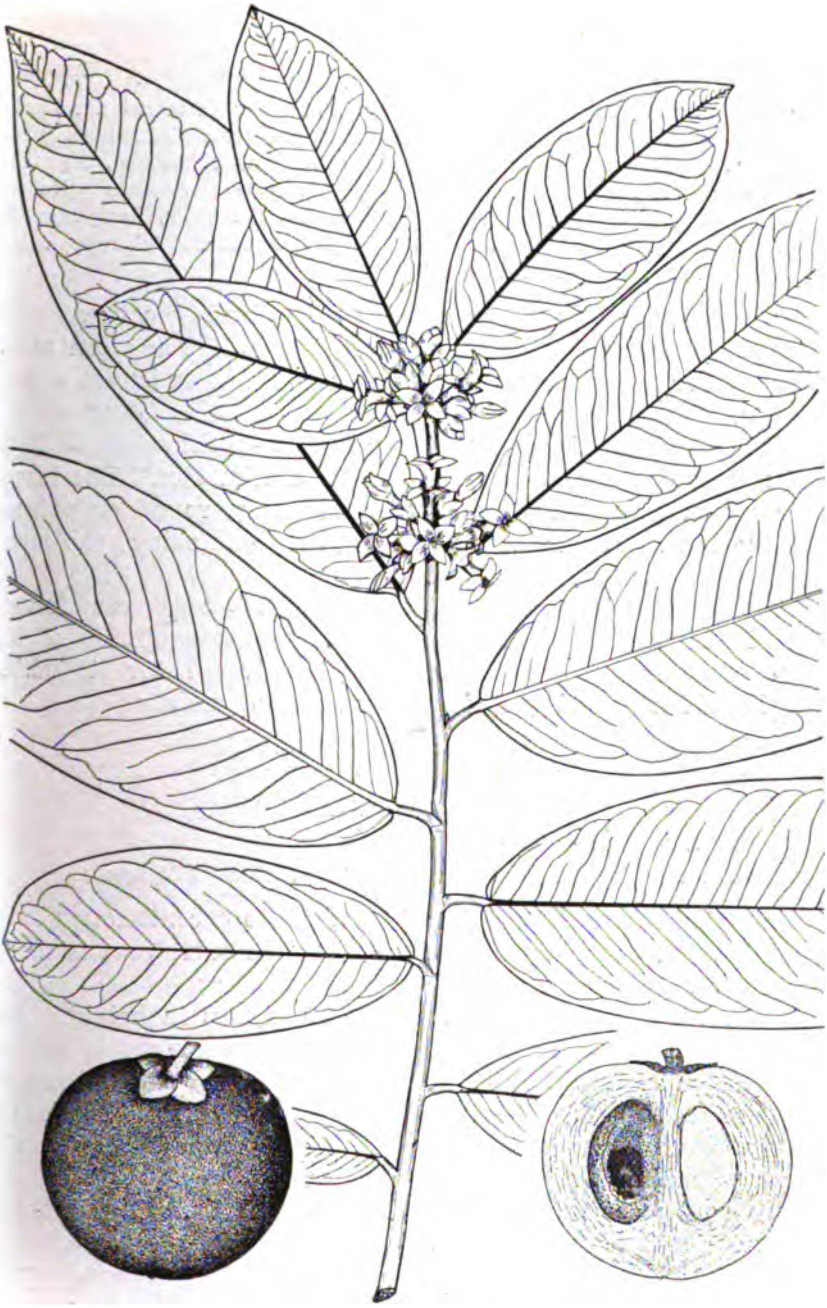


FIGURE 80. DIOSPYROS DISCOLOR (KAMAGONG). ×½.

Family EBENACEAE

Genus DIOSPYROS

DIOSPYROS DISCOLOR Willd. (Figs. 80, 81). CAMAGÓN * or KAMAGÓÑG.

Local names: *Baling-agtá* (Cagayan); *kamagóng* (Pangasinan, Zambales, Nueva Ecija, Manila, Cavite, Batangas, Tayabas, Camarines, Albay, Laguna, Sorsogon, Mindoro, Leyte, Dinagat Island, Surigao, Agusan); *itom-itóm, malasantól* (Butuan); *itúman* (Leyte); *kamáya* (Batanes Island); *mabúlo* (Cagayan, Ilocos Norte, Union, Zambales, Pampanga, Rizal, Bataan, Cavite, Nueva Ecija, Manila, Guimaras Island); *tálang* (Rizal, Bataan, Pampanga).

The fruits are large, rounded, fleshy, densely covered with brown hairs, and have a disagreeable odor. They contain a few rather large seeds. The fruits are edible and have a good flavor.

Diospyros discolor is a tree reaching a height of about 25 to 32 meters and a diameter of 60 to 80 centimeters. The leaves are alternate, leathery, pointed at the apex, round or pointed at the base. The upper surface is green and shiny; the lower covered with soft, pale hairs.

This species is common and widely distributed in the forests of the Philippines from Luzon to the southern limits of the Sulu Archipelago. It is frequently cultivated for its edible fruit, which is widely known as mabólo or mabúlo.

Family APOCYNACEAE

Genus OCHROSIA

OCHROSIA LITTORALIS Merr.

Local names: *Labusei* (Sibutu Island); *pakoidan* (Cagayan).

The fruits are united at the base, 2.5 to 4 centimeters long, and 1 to 1.5 centimeters in diameter. The outer part is fleshy and covers a stone containing edible seeds.

Ochrosia littoralis is a tree 2 to 10 meters in height. The leaves occur in whorls of three or four, and are smooth, pointed at both ends, 6 to 8 centimeters long, and 2 to 2.5 centimeters wide; the petioles 4 to 5 millimeters long or shorter. The flowers are yellow and have a slender, cylindrical corolla-tube, which is about 6 millimeters long.

This species is distributed from northern Luzon to the southern part of the Sulu Archipelago.

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* The Spanish pronunciation and spelling of the native Kamagóng.

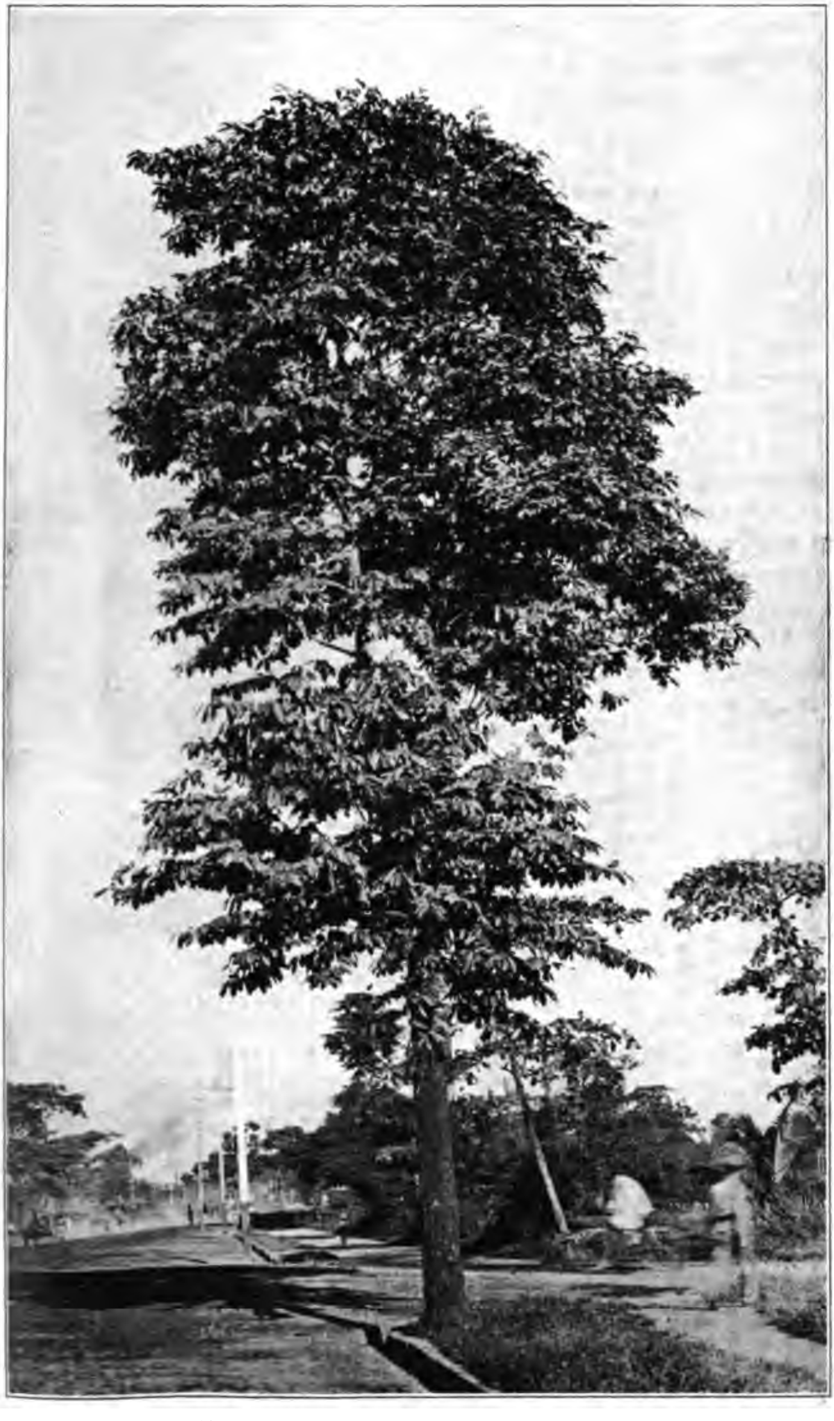

FIGURE 81. DIOSPYROS DISCOLOR (KAMAGONG).

OCHROSIA OPPOSITIFOLIA (Lam.) K. Sch. GINLÍN.

Local name: *Ginlin* (Basilan).

The fruit contains an edible seed.

Ochrosia oppositifolia is a fairly large tree. The leaves are thick, pointed at the base, and abruptly pointed at the tip.

This species has been reported only from Mindanao and Basilan.

Family ASCLEPIADACEAE

Genus TELOSMA

TELOSMA PROCUMBENS (Blanco) Merr.

Local names: *Dukep* (Union); *latok* (Bataan).

The immature fruits are cooked and eaten as a vegetable.

Telosma procumbens is a somewhat woody vine with slender, rounded, slightly hairy branches. The leaves are 8 to 13 centimeters long and 3 to 8 centimeters wide, thin, slightly hairy on the lower veins, pointed at the tip; the base rounded, straight or slightly heart-shaped. The flowers are greenish yellow, odorless, and about 1.5 centimeters in length. The fruits are about 15 centimeters long and contain flat seeds which have many soft, white hairs.

This species is widely distributed in thickets at low altitudes from northern Luzon to southern Mindanao.

Family CONVOLVULACEAE

Genus IPOMOEA

IPOMOEA REPTANS Poir. KANGKÓNG.

Local names: *Baláñgög* (Abra, Ilocos Sur); *galatgát* (Ilocos Norte); *kangkóng* (Pangasinan, Bulacan, Pampanga, Bataan, Rizal, Manila, Laguna, Tayabas, Camarines, Albay, N. Mindoro); *tangkóng* (Cagayan, S. Mindoro, Leyte, Cuyo Islands, Cotabato); *tangkúng* (Zamboanga).

The young leaves and stems are boiled and eaten as a vegetable. They have a slightly purgative effect.

Ipomoea reptans is a smooth vine trailing on mud or floating on stagnant pools. The leaves have long petioles, are 7 to 14 centimeters in length, with a pointed tip, and a heart- or arrow-shaped base. The corolla is purple and white, about 5 centimeters long, and about 5 centimeters in diameter. The capsules are ovoid and about 5 centimeters in length.

This species is common and widely distributed throughout the Philippines.

Family BORAGINACEAE

Genus EHRETIA

EHRETIA MICROPHYLLA Lam. KALAMOGÁ.

Local names: *Buntatai* (Negros); *cha* (Cagayan, Bataan); *chang-gúbat* (Laguna, Batangas); *echá-ti-bákir* (Ilocos Sur); *itsá* (Ilocos Norte); *kalamogá* (Tayabas); *kalimumug* (Cotabato); *mara-mara* (Ticao Island); *maratiá* (Cagayan).

The leaves of this plant are sometimes used locally as a substitute for tea.

Ehretia microphylla is an erect, much-branched shrub, 1 to 4 meters in height. The leaves occur in clusters on short branches. They are rough, 1 to 6 centimeters long, entire or somewhat toothed or lobed near the apex, with a narrow base, and a short petiole. The corolla is white, and 5 millimeters long. The fruit is yellow, rounded, the outer part somewhat fleshy, the inner part stony. It contains four seeds.

This species is common and widely distributed in thickets in the Philippines.

Family VERBENACEAE

Genus PREMNA

PREMNA NAUSEOSA Blanco. ALAGÁU-DÁGAT.

Local names: *Alagáu, alagáu-dágat* (Tagalog); *alagáu-blanco* (Zamboanga); *aragáu* (Davao); *argáu* (Negros).

The leaves of this species are sometimes used as a substitute for those of *Piper betle* for chewing with the seeds of *Areca catechu.*

Premna nauseosa is a shrub 1 to 4 meters in height. The leaves are opposite, smooth, somewhat oval, pointed at the tip, rounded or somewhat heart-shaped at the base, 7 to 14 centimeters long, and 5 to 7 centimeters wide. The flowers are small, and greenish or greenish white. The fruit is rounded, dark purple, fleshy, and about 4 millimeters in diameter.

This species is distributed along the seacoast throughout the Philippines.

Family SOLANACEAE

Genus CAPSICUM

CAPSICUM FRUTESCENS L. SÍLI OR CHILE PEPPER.

Local names: *Kasira* (Cotabato); *katumbal* (Culion); *ladá* (Camarines); *lará* (Davao); *síleng-botónes* (Cagayan); *síleng-labúyo* (Rizal, Cavite);

síli (Union, Bontoc, Mindoro, Batanes Islands, Batangas, Nueva Vizcaya, Balabak Island, Palawan).

The fruit of the common form is red, oblong, and from 1.5 to 2.5 centimeters in length. It has a very sharp taste and is used as a condiment.

Capsicum frutescens is an erect, branched, shrub-like herb 0.8 to 1.5 meters high. The leaves are pointed at the tip and 3 to 10 centimeters in length. The flowers occur singly or in clusters of a few in the axils of the leaves. They are pale green or yellowish green, and from 8 to 9 millimeters in diameter.

This species is a native of tropical America, but is now found in all tropical countries. It is occasionally found in waste places throughout the Philippines and is also commonly cultivated.

Genus LYCOPERSICUM

LYCOPERSICUM ESCULENTUM Mill. TOMATO.

Local names: *Kamátes* (Bontoc, Benguet, Rizal, Camarines); *kamátes-bondók* (Balabac Island).

In the Philippines there is a naturalized form of the common tomato with fruits about 1 to 1.5 centimeters in diameter.

Lycopersicum esculentum is a coarse, hairy, annual herb, with alternate, compound leaves. The flowers are yellow, and 1 to 1.5 centimeters in length. The fruit is rounded, red, contains many seeds, and is edible.

Genus SOLANUM

SOLANUM CUMINGII Dun. TALOÑGTALÓÑGAN.

Local names: *Balbalósa* (Camiguin Island); *bal-bal-lúsa* (Union, Pangasinan); *malvalúsa* (Cagayan); *tabulak* (Pangasinan); *taloñgtalóñgan* (Polillo, Marinduque); *taluñgtalúñgan* (Negros); *talingtaling* (Basilan); *tarambólo* (Bulacan).

The fruit of this species is rounded, smooth, about 2.5 centimeters in diameter, and green mottled with white, or yellow. The unripe fruit is cooked and eaten as a vegetable.

Solanum cumingii is a spreading or ascending, somewhat branched, hairy herb 30 to 60 centimeters in height. The stems, petioles and leaves are armed with scattered, sharp, rather stout spines, which are 3 to 6 millimeters long. The leaves are alternate, somewhat pointed at the tip, inequilateral at the base, irregularly lobed on the margins, and 4 to 12 centimeters in length. The flowers are violet or purplish, nearly 2 centimeters in diameter, and are borne in small numbers on small flowering branches which are in the axils of the leaves.

This species is widely distributed in open, waste places in the Philippines.

Family SCROPHULARIACEAE

Genus LIMNOPHILA

LIMNOPHILA ROXBURGHII G. Don. KALAÓO.

Local name: *Kalaóo* (Camarines).

This plant is aromatic and is used in cooking. It is also utilized to perfume the hair.

Limnophila roxburghii is an herb reaching a height of about 50 centimeters. The leaves are opposite, pointed at both ends, usually widest near the base, have toothed margins, and are from 3 to 12 centimeters in length. The flowers are about a centimeter long, purplish, and occur in clusters on stems which are found in the axils of the leaves or terminate the leafy branches.

This species is distributed from Luzon to Palawan.

Family BIGNONIACEAE

Genus OROXYLUM

OROXYLUM INDICUM (L.) Vent. PINGKAPINGKÁHAN.

Local names: *Abang-ábang* (Guimaras Island); *balai-uák* (Zamboanga); *balílang-uák* (Tagalog); *barañgáu* (Abra, Ilocos Sur); *kampílan, kakampílan, kamkampílan* (Ilocos Sur, Isabela, Pangasinan); *maidbaíd* (Camarines); *pinggapinggáhan* or *pingkapingkáhan* (Tagalog); *tagbiláu* (Tagalog).

The unripe fruits of this species are cooked in a variety of ways and eaten as a vegetable.

Oroxylum indicum is a small tree 4 to 12 meters in height. It has few or no branches. The leaves are 1.5 meters in length and 3- or 4-pinnate. The leaflets are numerous, pointed at the tip, and 5 to 15 centimeters long. The corolla is about 6 to 7 centimeters long, dark purple, and bell-shaped. The fruit is a capsule, up to 1 meter in length, about 8 centimeters wide, and 1 centimeter or less in thickness. The seeds, including the very thin wings, are up to 6 centimeters wide.

This species is common and widely distributed from northern Luzon to Basilan.

Family CUCURBITACEAE

Genus MOMORDICA

MOMORDICA CHARANTIA L. AMPALAYÁ.

Local names: *Amargóso* (Spanish-Filipino); *saligum* (Basilan); *ampalayá* (Manila, Tayabas, Balabac Island); *ampaleyá* (Bataan); *apalyá* (Marinduque); *maragóso* (Surigao); *pariá* (Camarines); *pariam* (Bontoc).

The fruit is oblong, cylindrical, pointed at both ends, ribbed and wrinkled. The wild forms are from 2 to 3 centimeters in length and the cultivated ones up to at least 25 centimeters in length. The fruits and young growth are boiled and eaten by the Filipinos with meat and other vegetables.

Momordica charantia is an herbaceous, annual vine, climbing by tendrils which are up to 20 centimeters in length. It is nearly or quite smooth. The leaves are heart-shaped at the base, 2.5 to 10 centimeters in diameter, and cut nearly to the base into five or seven variously toothed and divided lobes. The flowers occur in the axils of the leaves on long stalks. They are yellow and about 12 millimeters long.

This species grows in thickets and waste places throughout the Philippines, and is also extensively cultivated for its edible fruits.

MOMORDICA COCHINCHINENSIS Spreng. TABOG-ÓK.

Local names: *Bayok-bayók* (Mindoro); *libás* (Ilocos Sur); *parog-párog-ti-noáng, parog-párog-ti-táwo* (Union); *parug-párug* (Cagayan); *tabog-ók* (Camarines).

The young leafy shoots are cooked as a vegetable. The pulp of the fruit is also edible.

Momordica cochinchinensis is a coarse vine reaching a length of 15 meters and climbing by means of tendrils. It is slightly hairy or nearly smooth. The leaves are 8 to 18 centimeters long, deeply three-lobed, or sometimes entire, the base heart-shaped. The petals are pale yellow, and from 3.5 to 4 centimeters long. The fruits are ovoid or somewhat rounded, 8 to 12 centimeters in diameter, yellow, and roughened with scattered tubercle-like spines.

This species is distributed from northern Luzon to southern Mindanao.

Family COMPOSITAE

Genus BIDENS

BIDENS CHINENSIS Willd. ANGGUÁT.

Local names: *Anguar* (Nueva Vizcaya); *angguát* (Benguet); *purpurikit* (Ilocos Norte); *tagob* (Mindoro).

The Igorots of Benguet mix this plant with half-boiled grains of rice in making rice wine, or tafei.

Bidens chinensis is an herb about a meter in height, with yellow flowers and lobed, toothed leaves.

This species is distributed from northern Luzon to Mindanao.

BIDENS PILOSA L. PURÍKET.

Local names: *Ang-n͠guád* (Benguet); *dadayem* (Batanes Islands); *puríket* (Bontoc, Union).

This plant is used in making an Igorot wine called sinitsit.

Bidens pilosa is an erect, branched, more or less hairy herb 0.2 to 1.5 meters in height. The leaves are up to 15 centimeters in length, the upper ones usually much smaller. They are once or twice pinnately divided. The flowering heads are about 8 millimeters long, the disc flowers brown or yellowish, the ray ones yellow or nearly white. The seeds are black, 1 to 1.5 centimeters long, with four projections at the apex.

This species is very common and widely distributed from northern Luzon to southern Mindanao.

Genus EMILIA

EMILIA SONCHIFOLIA (L.) DC. TAGULÍNAU.

Local names: *Kipot-kipot* (Sorsogon); *marcilanana* (Laguna); *mulumustasa* (Negros); *tagulinas* (Tayabas); *tagulínau* (Polillo, Manila); *yayod-no-kangkáng* (Batanes).

This species is cooked and eaten as a vegetable.

Emilia sonchifolia is an erect, smooth or slightly hairy plant, which is 10 to 40 centimeters in height. The leaves are somewhat fleshy; the lower ones are lobed and 5 to 10 centimeters in length. The flowering heads are purple and 12 to 14 millimeters long.

This species is found from northern Luzon to Basilan in open grasslands and waste places.

Genus SONCHUS

SONCHUS OLERACEUS L. GAGALANG.

Local name: *Gagalang* (Benguet).

This species is used as greens. According to Heyne,* it is cultivated in some parts of Java.

Sonchus oleraceus is an erect, annual, hairy or slightly glandular herb, 40 to 60 centimeters in height. The leaves are alternate, 10 to 20 centimeters long, and very coarsely lobed. The flower heads are about 1 centimeter long, and yellow.

This species is found occasionally in disturbed or cultivated soil, especially in the Mountain Province.

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 4, page 254.

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THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF FORESTRY

Annual Report of the Director of Forestry of the Philippine Islands

For the Fiscal Year Ended December 31, 1920

ARTHUR F. FISCHER
Director of Forestry

MANILA
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ANNUAL REPORT OF THE DIRECTOR OF FORESTRY.

MANILA, *March 1, 1921.*

SIR: In the absence on leave in the United States of the Director, I have the honor to submit the Annual Report of the Bureau of Forestry for the fiscal year ending December 31, 1920.

LEGISLATION.

Act 2898, appropriating the sum of ₱4,000 for the purchase and installation of a plant for distilling water for the Forest School at Los Baños, Act 2902, amending section 1840 of the Administrative Code, to extend the period for the free cutting of second and lower group timbers until October 25, 1925, and Act 2906, assigning the sum of ₱23,208.33 to be used in the classification of lands are the laws affecting the Bureau of Forestry which were passed during the year 1920.

Other legislative matters issued which affect the Bureau are:

By the Governor-General: Proclamation No. 60, series of 1920, changing the name of the Mount Makiling Forest Reserve to "The Mount Makiling National Botanic Garden."

By the Department of Agriculture and Natural Resources: Amendment of section 12 of the Forest Regulations regarding kaiñgins; Administrative Circular No. 5, series of 1920, new schedule of charges to be collected for certain classes of work executed by the Bureau of Forestry; Administrative Circular No. 7, series of 1920, regarding the bond to be exacted before issuing any ordinary license.

By the Department of Finance: Regulation No. 18 (Sept. 30, 1920) increasing the forest charges on minor products.

Beside the above, this Bureau submitted to the Committee on Finance a proposed law increasing the forest charges and establishing a more efficient system for the classification of forest products, the collection of forest charges and the compilation of statistics of forest utilization, and a new standardization of the salaries of the Bureau of Forestry personnel.

PERSONNEL.

The question of personnel, especially that of the field force, which has for years been becoming increasingly acute, finally reached such a state that it was necessary to appeal to His Excellency, the Governor-General, to revise the civil service standing of rangers, who had been rated as second grade civil service employees eligible to a maximum salary of ₱1,800 per annum. The Governor-General changed this rating, and now Rangers are in a special classification because of their training and will receive an entrance salary of ₱900 to ₱1,080, depending upon their education, and can attain a maximum salary of ₱2,400.

As for the higher technical force, the same difficulties as before have been encountered, it being impossible to secure experienced foresters at the salary that can be offered to them.

The high cost of living and also the higher pay and better opportunities offered by others to the field and office force have given rise to a continuous stream of resignations. In spite of the restrictions placed upon resignations and of efforts to hold the men, forty-three persons resigned. These are classed as follows: Three technical men; 1 lumber inspector; 2 foresters; 15 rangers (all of these vacancies remain unfilled); 20 clerks and 2 draftsmen. These resignations, together with the absences of men on leave, have seriously curtailed and hampered the work of the Bureau.

The classified force on December 31, 1920, consisted of: One Director (on leave), 9 foresters, 1 technical employee, 1 lumber inspector, 1 wood expert, 1 assistant forester, 11 forest supervisors (9 in active service, 2 in the United States as pensionados), 121 rangers, 7 draftsmen, 43 clerks and 2 messengers, making a total of 198. The temporary employees were: Four rangers, 1 proofreader, 104 guards, 2 junior stenographers, 10 clerks, 3 draftsmen, 5 nurserymen, 7 carpenters, 2 varnishers, 1 chauffeur, 1 messenger, 2 watchmen, 5 janitors, and 1 laborer, making a total of 148. The entire force on December 31, 1920, was therefore 346 employees.

DIVISION OF FOREST MANAGEMENT.

The Division of Forest Management is charged with the use and protection of the forests of the Philippines, the investigation of the extent of forest resources, the inspection of licenses and the supervision of the work of the field forces.

At the end of the year there were on the rolls of this Division, the following field and office force: Four foresters, one assistant forester, six forest supervisors, seventy-two rangers, thirty-two guards, and eighteen clerks.

The force of this Division has maintained a high standard of efficiency notwithstanding the increased volume of work and of handicaps owing to lack of personnel and appropriation. It is perhaps unnecessary to call attention to the fact that these men are receiving lower salaries than those paid to men of similar technical positions and responsabilities in other Bureaus and much less than what their former colleagues are earning in civil life. Also, their field work entails unusually heavy expenses for shoes and clothing, and, owing to their very limited income, they are unable to support themselves and their families except at a scale of living which is intolerable to University graduates. This state of affairs has a disastrous effect, not only upon the personnel, but also upon the service, inasmuch as the wealthy and educated class of our society can not become properly acquainted with our aims and policies through the Rangers due to that lack of association and contact which would otherwise be possible, were the rangers given such remuneration as would better their living conditions, and enable them to assume their proper place in the life and activities of the community.

The foregoing is cited as one of the reasons for requesting better remuneration for the personnel of this Division, aside from the fact that higher pay and better opportunities are offered outside to the men. This subject is more fully discussed under "Personnel."

INSPECTION.

The following table shows the Forest Stations throughout the thirteen districts inspected during the year 1920 by the supervising personnel of the Manila office:

District No.	Station.	Inspected by—	Date, 1920.	Report.
1	Aparri	A. Suyat	July 1–5	1
	Alcala	do.	June 28–29	1
	Ilagan	do.	June 25–26	1
	Echague	do.	June 18–23	1
2	Vigan	do.	July 7	1
	Bangued	do.	July 9	1
3	Baguio	E. C. Leaño	Oct. and Nov	
	Tagudin	A. Suyat	July 11	
4	Dagupan	do.	Jan. 8	
	Cabanatuan	do.	Feb. 9	
	Do	P. San Buenaventura	June 13	
	Cuyapo	A. Suyat	May 24	
	Bayombong	do.	June 14–16	1
5	Laguimanoc	do.	March 11–12	1
	Calauag	D. P. Miranda	Oct. 9–15	1
	Baler	P. San Buenaventura	June 5–9	1
6	Naga	E. C. Leaño	June 18–20	1
	Do	P. San Buenaventura	Nov. 6–8	1
	Paracale	E. C. Leaño	June 30–July 2	1
	Legaspi	do.	June 13–14	1
	Sorsogon	P. San Buenaventura	Oct. 26–Nov. 4	1
	Legaspi	do.	Oct. 22–23	
	Sorsogon	do.	Nov. 26–Dec. 9	
	Do	E. C. Leaño	June 10–11	1
	Catabañgan	D. P. Miranda	Oct. 16–30	
	Virac	do.	May 18–20	1
7	Iloilo	P. San Buenaventura	Feb. 26	
	Do	F. L. Pray	July 6–7	
	Do	A. Suyat	Dec. 16	
	New Washington	do.	July 18	
	Do	P. San Buenaventura	Feb. 27–28	
	Cadiz	F. L. Pray	July 1–2	
	San Carlos	P. San Buenaventura	Feb. 21–23	
	Do	A. Suyat	Oct. 5–Dec. 15	
	Fabrica	D. P. Miranda	May 26–June 30	
	Ilog	F. L. Pray	July 18–19	
8	None			
9	Puerto Princesa	A. L. Cenabre	March 15	1
10	Tacloban	P. San Buenaventura	May 2–5	1
	Do	D. P. Miranda	Jan. 1–26	
	Catbalogan	P. San Buenaventura	April 24–26	1
	Masbate	do.	April 21	
	Do	do.	Aug. 10–13	
11	Tanay	P. San Buenaventura	June 28–29	1
	Orani	do.	March 21	1
	Do	Pray, Buenaventura, and Miranda	Sept. 10–11	
11	Limay	D. P. Miranda	Sept. 12–13	
	Arayat	A. Suyat	Sept. 16–18	
	Orani	A. L. Cenabre	Dec. 22–28	
	Norzagaray	P. San Buenaventura	March	
12	Calapan	A. Suyat	March 9	1
	San Jose	do.	April 22–May 7	3
13	Cebu	P. San Buenaventura	Feb. 17–18	
	Talisay	do.	Feb. 13–15	1
	Cebu	do.	May 13–15	

The foregoing table shows that there were more forest districts inspected in 1920 than in the past year. More extensive inspections might have been made, but only five of the nine forest supervisors were able to go into the field, three having been more or less permanently assigned to the Manila office, while the other two are in the United States as Government pensionados.

In addition to inspecting the activities of the forest officers in the provinces, aiding them in the solution of the different forest problems in their respective districts and in the investigation of troubles between licensees, or between licensees and forest officers, the forest supervisors have also coöperated with the Division of Forest Lands and Maps in reconnaissance work and in the classification of public lands. One forest supervisor is assigned to the Division of Sawmills and Utilization to inspect the work of ranger-scalers and the operation of sawmills.

LICENSE STATISTICS.

During the year 1920, there was a decrease of 470 in the number of ordinary timber licenses issued as compared with 1919, a total of 2,480 being in force at the end of the year. (This does not include those which were returned or cancelled, which totaled 250.) This decrease was due in part to a considerable increase in the number of sawmills, for which larger license areas were created by the consolidation of several small license areas, and in part by the cancellation of licenses which were not being used.

In respect to gratuitous licenses, there was a very noticeable increase, only 1,415 being issued in 1919, whereas this year there were 2,691, an increase of 1,276. This is attributable to the general prosperity of the Islands during the year and the higher living standard prompted by more general education, which resulted in the building of better homes under the Free Use Law. Also, the excessively high prices of lumber in the local markets prompted the people to get their own timber.

In addition to the above, there were 728 tobacco curing house gratuitous licenses issued during the year.

Of licenses covering minor forest products, a total of 3,911 were issued, showing a decrease of 1,268 from those of the previous year. The diminution was due in part to the exhaustion of firewood areas during the previous two years, when the high price of coal forced the use of firewood as a substitute, and to the greatly reduced market price of rattan, which has caused its collection to be suspended in many districts.

Tables showing in detail the licenses issued and the amount of forest products utilized during the year and a comparison of the totals of each with those of the previous year will be found in the appendix.

OFFENSES OF LICENSEES.

There was a considerable decrease in the offenses of licensees during 1920, due to more frequent inspections of license areas, the increased efficiency in patrol work by forest guards and partly to a fuller realization by the licensees of their obligation to observe the rules and regulations of the Bureau of Forestry and of the fact that violations of the same would cause the forfeiture of the license.

Of the two new causes of trouble in the management of licenses described in last year's report, viz.: (1) Trading in licenses, and (2) the attempts by licensees, or persons interested in a license, to enlarge their territory to the prejudice of adjacent licensees, there has been little or no improvement in the former case, but a marked improvement has taken place in the latter, due mainly to the more careful location of the boundaries of all license areas, particular attention having been paid to this by the forest officers when they inspected the areas. Continued improvement was noted in the reduction of the amount of wasted and abandoned forest products due undoubtedly to the realization on the part of the licenses that they would have to pay for such material owing to the more frequent inspections by forest officers.

OFFENSES OF NON-LICENSEES.

The campaign of education on forestry subjects, the increased number of inspections of license areas and the more extensive and intensive patrol work by forest guards, together with the closer supervision of their cutting areas by the licensees, have materially reduced the illegal cutting by non-licensees.

The noted increase in the item "Total fines and penalties" as given in Table No. 4 in the appendix is due to increased activities in the production of manufactured ties, on which the surcharges for manufactured timber are imposed, and to kaiñgin cases acted upon administratively.

FUTURE SPECIAL WORK.

1. Every effort will be made to obtain a permanent corps of forest guards. These men should be put on a permanent basis, under the Bureau of Civil Service, in order to keep them after they have been trained. The employment of guards is warranted by the fact that the experienced guards are turning

in invoices for timber and other forest products cut illegally, which total more than their expenses and salaries, thus showing a clear profit for the government in such work as kaiñgin prevention, inspection of licenses, and the reduction of theft of forest products and other violations of the forest laws. This benefit always follows the inauguration of an adequate patrol and inspection system.

2. There will be a continuation of mangrove swamp work, namely: Mapping, inspection of cutting areas, planting supervision and the study and development of fishponds, in connection with the scientific management of the mangrove swamps.

3. The deposit of bonds guaranteeing the good faith and conduct of the licensees has become an imperative necessity. It is proposed to require each licensee to deposit with the Director of Forestry a cash bond amounting to ten per cent of the value of the forest charges on the total quantity of forest products granted on the face of the license. This will cause the prospective licensee to apply only for the amount of forest products which he will be reasonably certain of cutting, and it will also enable the forest officers to judge of the extent of territory which will be required to meet the needs of the licensee. This bond should also do away with applications from those persons who apply for a license with the sole intention of speculating (selling the cutting privileges) in the same.

SPECIAL PERMITS SECTION.

The work of this section, which consists in carrying out the provisions of section 1838 of the Administrative Code and the issuance of ordinary minor products licenses falling under lease, agreement, or the special use clauses in the above-mentioned section, as well as the issuance of kaiñgin permits, has from its organization in the latter part of 1919 been entrusted to different forest supervisors, and not until the middle of the year has a forest supervisor been permanently assigned to take charge of the section. A senior ranger has been designated to assist him in this work.

The ranger assistant has devoted almost all of his time to investigative work in the field, thus leaving the office work entirely in the hands of the forest supervisor in charge. In spite of this fact, and considering the great mass of correspondence and applications for special uses that have been filed, it is gratifying to note that this section has been running satisfactorily, and it is hoped that in the coming year the work will be further developed.

SPECIAL USES.

Up to the end of the year, there were issued 5 lease agreements for fishponds, 7 for saltworks and 1 for a sawmill site, 13 pastures permits, and 1 minor product license agreement, as compared with 2 fishpond lease agreements and 1 pasture permit for the previous year.

The following applications on different special uses are held pending: Thirty-eight with contracts prepared, but awaiting the applicants' signatures; 13 with contracts approved by the Department Secretary, but pending receipt of the required bonds from the applicants; 9 with action suspended until such time as the competent court has duly determined the conflicting claims on the areas applied for; 51 with necessary contracts prepared, but to be checked first before sending them to the applicants for signature; and 31 awaiting examination by the field force.

The foregoing figures show that, as the benefits of section 1838 of the Administrative Code became better known throughout the provinces, there has been an increase in the number of applications and, of course, this involved a corresponding increase in the work of the Bureau. The inability of the present personnel to make the necessary examinations as promptly as is desirable is a subject worthy of careful consideration.

KAIÑGINS.

The total number of illegal kaiñgins reported to the courts during the year amounted to 721 as against 603 during 1919. which shows an increase of 118. The number of successful cases amounted to 184 as against 156 during 1919, or an increase of 28. These results are due to four factors: (1) Greater ability in the presentation of evidence displayed by the field force: (2) more time devoted by the field force to this kind of work; (3) gratifying coöperation of the provincial fiscals; and (4) better understanding on the part of the justices of the peace, who handled most of the cases, of the importance of preventing the destruction of public forests by kaiñgin makers. This Bureau, therefore, did not have any occasion to complain, as it did in the past years, as regards the coöperation on the part of the provincial fiscals and the justices of the peace. Part of the kaiñgins can be attributed to the efforts of persons who are trying to increase their land holdings and also to a misunderstanding of the food campaign. The following table shows umber of kaiñgin cases reported from each province with umber acted upon during the year:

4-25

ins reported during the fiscal year 1920. (January 1 to December 31, 1920.)

Province.	Reported by—		Total.	Acted on—		Total.
	Forest officers.	Municipal president.		Convicted.	Acquitted.	
	22		22			
Camarines	42		42		1	1
a.	17		17			
s.						
us.						
		2		2	2	2
m						
	17		17	17		17
a.						
	19		19	8		8
	7		7		1	1
o						
	1		1		1	1
Norte.						
Sur.						
	2		2			
on						
	57		57	27	5	32
luque.						
ro	28		28			
s	16		16			
ain Province.						
Ecija.		3	3	3		3
Vizcaya						
Occidental.	81		81	38	9	47
Oriental.	2		2	1		1
n	23		23			
ga	28		28	5	9	14
nan.	52		52			
	10		10		6	6
a.	47		47			
	50		50	35		35
n.	177		177	39		39
s.	10		10	9		9
es	8		8			
nga						
otal.	716	5	721	184	32	216

FOREST DISTRICTS AND STATIONS.

r the purpose of administering the field work of the Bureau orestry, the Philippine Islands have been divided into thir- districts with Foresters or competent Rangers in charge of ea.

In each district there are forest stations which are so located as to administer the work to the best advantage. From time to time, as lumbering develops or new roads are opened or steam-ship service improves, new stations are added or old ones transferred to other points. A number of changes have been made during the year.

During 1920, new stations were opened at:

Claveria, Cagayan Province	District No. 1.
Cabibihan, Tayabas Province	District No. 5.
Cagayan, Misamis Province	District No. 8.
Port Lebak, Cotabato Province	District No. 8.
Maluso, Zamboanga Province	District No. 8.
Jolo, Sulu Province	District No. 8.
Mati, Davao Province	District No. 8.
Laoang, Samar	District No. 10.

The Forest Stations at Baler of District No. 5, Tagudin of District No. 3 and Cabanatuan of District No. 4, were closed.

SUMMARY OF REPORTS FROM FOREST DISTRICTS.

The following are extracts from the annual reports submitted by the officers in charge of districts. Many of these reports contain considerable information which is omitted for lack of space.

District No. 1: Headquarters, Aparri, Cagayan.—Provinces: Cagayan, Isabela, and the northern portion of Ilocos Norte.

Area: 10,155.6 square miles.

Personnel on December 31, 1920: Five rangers, 1 forest guard, and 1 clerk.

In spite of the business depression since September, all licenses have been very busy because the price received for timber doubled during the year. Lack of transportation has hampered the delivery of some timber, but as a rule logs were sold and used as soon as they were brought to a market.

Rattan collecting has been pushed, but even so, the demand was so great that the price of split baling rattan 5½ meters long rose to ₱22 per thousand.

Zones were established within which persons, especially mountaineers, who had no work animals could clear land and plant crops. This method obviates the need of granting individual permits to clear land and at the same time protects the forests from destruction by irresponsible settlers.

District No. 2: Headquarters, Vigan, Ilocos Sur.—Provinces: Ilocos Norte (except Bangui), Ilocos Sur, and Abra.

Area: 3,588.8 square miles.

Personnel on December 31, 1920: Three rangers and 3 forest guards.

All timber cut in the district is solely for local use. Abra Province exported scarcely any logs, as all were used in local public works. The result was that Vigan and the coast towns in general were obliged to get timber elsewhere.

The conditions in the forests are satisfactory, but unfortunately there are not enough men in the service to prevent the cutting of seed trees which have been left by licensees to restock the forest. It is necessary to appoint firewardens to protect the recently planted areas near certain towns of this district.

No illegal kaiñgins were found in public forest. Permits to clear brush land were issued to 161 persons who employed over 400 people to help them clear the land on shares.

Twelve reforestation plots and two forest tree nurseries are located in a dozen towns of the district, and these are serving as an object lesson in reclaiming unproductive kogon land. This work should be extended as rapidly as means will permit.

District No. 3: Headquarters, Baguio, Mountain Province.—Sub-provinces: Amburayan, Benguet, Bontoc, and Lepanto.

Area: 3,419.6 square miles.

Personnel: 1 forester, 3 rangers, and 9 guards.

The local demand for timber has been very large, in fact larger than the mills could supply. The Heald Mill has installed new equipment and is now in a position to fill all orders.

The miners have been busy cutting mine props and lumber for themselves. Over 16,000 board feet were sent to La Union for a bridge and a wharf.

Nearly 15,000 cubic meters of firewood were invoiced during the year and providing for a future supply is a serious problem.

The making of charcoal is proving profitable, and for this purpose, licenses have been issued in localities where logging waste which could not be used as firewood could be converted into charcoal.

All reforestation work in this district is dependent upon the prevention of fires. Until fires can be prevented or extinguished promptly when started, it will be useless to expect pine trees to occupy the grass covered hills. As the development of Mountain Province and especially of the mines is dependent upon timber, a serious effort should be made to carry on systematic fire protection work on a large scale. The present force is as large as funds will permit, but is entirely inadequate to cope with the extreme fire hazard found in the grass lands. The restriction of grazing to open land has done much to reduce the number of fires, but there is nothing to prevent the spread of fires if once they get started.

Furthermore, any control of floods in Pangasinan and development of hydro-electric projects on the Agno River are dependent upon the forest cover of the mountains comprising the basin of this river. It is safe to say that over three-fourths of the mountainous region in which this river rises is grass land. The slopes are steep and the surface run off is very rapid, thus giving rise to destructive freshets in the plains of Pangasinan. Diverting the river into swamps in Tarlac and Pangasinan will relieve the situation, but it will not remove the cause of the floods.

District No. 4: Headquarters, Dagupan, Pangasinan.—Provinces: Nueva Ecija, Nueva Vizcaya, Pangasinan, Tarlac, and Union.

Area: 8,718.0 square miles.

Personnel: 5 rangers and 7 forest guards.

All lumber used in this district comes from Manila or from Masinloc, Zambales. However, logging in the district was very active, particularly in securing posts both for house construction and for electric transmission lines, until the floods on the Agno River for two months and the scarcity of laborers during the rice harvest stopped operations, leaving many contracts unfulfilled.

The Luzon Ship Building Company has a small mill for cutting logs. Such material as is not needed for the ships is sold at Dagupan. Two schooners, a launch and over twenty lighters were completed during the year and others are on the ways.

The number of minor product licenses decreased because inactive licensees were requested to return their licenses.

The extensive inspection trips of forest officers resulted in invoicing abandoned or stolen timber amounting to ₱3,300.

The most important lines of work for the coming year are the establishment of concessions in mangrove swamps and the establishment of forest zones in the district, and if funds permit, reforestation work should be undertaken in Union Province and elsewhere where the lack of water for irrigation is felt. In 1917, a farmer of Salasa, upon the recommendation of the Bureau of Forestry planted ipil-ipil (*Leucaena glauca*), in a kogon-covered valley which had been kaiñgined in 1915. Before 1915, he depended upon a spring for water to irrigate his field, but after the hill sides had been cleared off, the spring had dried up. The ipil-ipil has established a good forest cover and the spring is now flowing all year long.

Farmers around Mount Balungao, Pangasinan, are clamoring for reforestation because the springs at the base of that peak have dried up.

District No 5: Headquarters, Los Baños, Laguna.—Provinces: Batangas, Laguna, Marinduque, and Tayabas.

Area: 6,184.9 square miles.

Personnel: 1 forester, 9 rangers, 1 guard scaler, 12 guards, and 1 clerk.

Because of the high prices received for copra and abaca during the year 1919, there was considerable building going on during 1920. Concrete warehouses, stores and residences were built and a large number of wooden houses were erected in every town.

The mills at Calauag and Kabibihan furnished most of the lumber and local licensees furnished house posts and special dimension stuff. High wages, the lack of laborers, and the slump in the copra and abaca market had their effect upon the lumber output and toward the end of 1920 there was a great decrease.

A number of small licensees are ordering or erecting sawmills and it is feared that they are doomed to failure because the number of competent sawmill operators in the Philippines is limited. However, there is no reason why they should not succeed with competent managers in charge, for the supply and the market are both ample. One mill is shipping two carloads of ties per day for railroads in China. The climate of China will permit the use of apitong ties.

The change in the land law is not fully understood by the people and it is feared that misinformed or unscrupulous persons will occupy forest land and destroy forests under the pretext that they are homesteaders. In order to prevent this and other abuses, it is recommended that permanent national forests be established as soon as possible and that every effort be made to dispose of the timber upon agricultural land either by selling it to licensees or to purchasers of the land. It is further recommended that licensees be required to clear cut on agricultural land in order that it may be certified for agriculture.

District No. 6: Headquarters, Naga, Camarines Sur.—Provinces: Camarines Norte, Camarines Sur, Albay, Sorsogon, and Catanduanes.

Area: 6,665.5 square miles.

Personnel: 8 rangers, 2 guard-scalers, 10 forest guards, and 1 clerk.

There hase been a great increase in the activities of timber and firewood licensees, except in Paracale, where mining operations were suspended while the dredges were shifted to new placer claims. The increased output can be attributed to high prices, abundant labor and better transportation. The increased demand for timber is accounted for by new railroad construction, development work on the Batan Island coal mines, installation of six new municipal electric lighting systems and the extension of others, rebuilding after the Legaspi fire, general building in the district and export to Manila. In 1919 only five licensees shipped logs to Manila. During 1920 practically all licensees on the west coast and five on the east coast of the district sent logs to Manila. Schooners equipped with motors are responsible for this sudden development in the logging industry.

Eight shipyards are in operation, two being newly established. These yards turn out motor launches, native sail boats, schooners and occasionally schooners with motors. Three of these yards have their own vessels to bring them lumber.

As a result of this activity, the demand for licenses is so great that several applicants have offered to pay forest charges in advance, if necessary, in order to get licenses. The price paid for narra trees growing in abaca plantations, ranges from two to ten pesos and abaca growers are therefore felling most of the narra shade trees.

The establishment of forest zones has been begun and should be pushed with vigor in order to prevent further encroachment upon the forests.

District No. 7: Headquarters, Iloilo, Iloilo.—Provinces: Antique, Capiz, Iloilo, and Occidental Negros.

Area: 8,332.9 square miles.

Personnel, December 31, 1920: 11 rangers, 4 guard scalers, and 14 guards.

Lumber dealers report that they are selling twice as much lumber as formerly and that they cannot supply the demand. The high price received for sugar has stimulated building throughout the district, hence the demand for lumber, although the price of the latter has also doubled.

The great demand for timber of course attracted persons who cut and sold timber without paying for it. The forest charges on products cut by such persons as were detected by forest officers amounted to more than ₱14,000.

The over-cut mangrove swamps are in crying need of reforestation and protection. During the fuel famine, it was necessary to get firewood wherever possible, and as a result mangrove swamps have been stripped of all but the least salable species. Unless something is done, the extensive swamps near

Iloilo will be restocked by the most worthless species and will thus be ruined as a future source of firewood.

District No. 8: Headquarters, Zamboanga, Zamboanga.—Provinces: Bukidnon, Misamis, Cotabato, Davao, Jolo, Lanao, and Zamboanga.

Area: 31,899.6 square miles.

Personnel: 1 forester, 17 rangers, 5 guard-scalers, 9 forest guards, and 1 clerk.

Although all 15 mills have been busy, yet over 200,000 board feet of lumber were imported, via Jolo, from Borneo. On the other hand, the mills have exported nearly two million board feet to China and to the United States and requests have been received from Java and the Straits Settlements as to the possibility of furnishing 30,000,000 board feet. Seven caterpillar tractors are being tried out with very satisfactory results.

The time of the personnel is taken up with the operations of the licensees and no research work has been attempted. Such work should be undertaken early, preferably by trained men from the Division of Investigation. An effort will be made to place the mangrove swamps under management, because those near the large cities are becoming depleted. However, unless more men are available this and other will have to wait for a favorable opportunity.

The Jolo Teak Reservation is being logged by the provincial government and this is the time to undertake reforestation work there, as the forest is too open to produce as much timber as it should.

Very little can be done to check the destruction of forests by nomadic cultivators, because they lack animals or implements with which to plow the land and thus combat the grasses which are the bane of all farmers. An increase in personnel will enable forest officers to solve this problem properly by assigning settlers to brush land and showing them how to eradicate kogon by means of ipil-ipil or other shrubs, thus enabling the people to shift in a regular rotation from one parcel of brush land to an adjacent parcel until such time as they can plow the land and place the entire tract under cultivation.

District No. 9: Headquarters, Puerto Princesa, Palawan.—Province: Palawan.

Area: 5,617 square miles.

Personnel: 4 rangers and 1 forest guard.

The timber licensees have been unusually active trying to supply the demand for timber. As a result four licensees are using tractors and twenty-two launches are in use towing logs from points along the coast to a safe anchorage where they can be loaded on steamers or schooners. One result of using tractors is that logs which had lain in the woods for years because carabaos could not drag them out were handled with ease by a tractor.

In the midst of this prosperity, the money stringency made itself felt and all licensees have large stocks of timber on hand.

A closer supervision of loading operations was possible and there has been an increase in the forest charges collected.

The operations of the licensees are such that only ipil and kalantas are cut, leaving other valuable trees in the forest. Because the ships that touch at Palawan stop only at Manila, the Iloilo market has not been developed. It will be only a question of a short time before lumber dealers of Iloilo will be sending ships to Palawan for logs and, when that time comes, all merchantable logs will find a ready market. No mills have been established because the labor supply is scanty.

Palawan has extensive mangrove swamps which should be placed under management before they are destroyed by reckless cutting. However, this work cannot receive the attention it deserves unless a larger and more permanent force be provided.

There was an increase in the number of kaiñgins in Busuanga, which is attributed to the fact that the local forest officer was transferred and as the people believed that the station was closed they had no fear of detection and began destroying forests.

District No. 10: Headquarters, Tacloban, Leyte.—Provinces: Samar, Leyte (eastern part), Surigao, and Masbate.

Area: 11,124.2 square miles.

Personnel on December 31: 9 rangers, 1 guard-scaler, 7 forest guards, and 1 clerk.

Owing to the topography being suited for small operators all mills in the district are small, having an actual output of from 1,000 to 10,000 board feet per day. Eleven mills are in operation at the present time, two having been installed during the year. Six other licensees are erecting mills or have ordered them. The principal markets for sawn lumber are Cebu and Tacloban, while the chief markets for ties and poles are Negros and Cebu.

Speculators in licenses have given trouble by permitting timber thieves to invoice timber under their license or by squandering the money of their financial backers. Forest charges amounting to over ₱5,600 were collected because of wasted or abandoned timber or seed trees cut contrary to instructions.

Invoices totaling ₱10,200 were prepared for timber which had been cut without license for commercial purposes.

The forests of Masbate require protection from fire and illegal clearings. To this end, it is imperative that more forest guards be assigned to Masbate, at least during the dry season. It would also be well to consider Masbate for reforestation work. Some of the forest destruction can be attributed to overzealous workers in the food campaigns, who assured the people that it was permissible to destroy commercial forests in order to raise food. During the year, 327 *kaiñgin* cases were reported, involving over 11,000 cubic meters of merchantable timber. The forest charges due are over ₱19,400. Of these cases, 120 were convicted, 7 were acquitted and the balance, 200, are still pending.

District No. 11: Headquarters, Manila.—Provinces: Bataan, Bulacan, Cavite, Pampanga, Rizal, and Zambales.

Area: 5,106.1 square miles.

Personnel: 9 rangers, 2 guard-scalers, 10 forest guards, and 1 clerk.

The chief demand for timber is in the form of piling and dugout canoes. The piling is used extensively for foundations in Manila and the canoes are sold to fishermen on Manila Bay. The lumber industry has been poor, as lumber can be bought in Manila at prices which local timber cutters do not care to meet. Firewood, on the other hand, is in great demand and all such licensees have been busy.

Where steam logging operations are being conducted, it will be necessary to attempt some form of artificial regeneration, as the cut-over areas, if left to themselves, will not produce a satisfactory forest. Reforestation work should also be undertaken on Mt. Arayat, in Bulacan, Rizal, and Zambales.

District No. 12: Headquarters, Calapan, Mindoro.—Province: Mindoro.

Area: 3,981.6 square miles.

Personnel: 5 rangers and 2 guards.

The chief timber species exported from Mindoro are guijo and kalantas, with the result that these trees are no longer found near the coast. An effort should be made to market other species, but as long as timber brokers in Manila make excessive deductions for alleged defects, refuse to pay for the entire volume of the log and by various other tactics beat down the price to the licensees, the licensees will not go to the expense and trouble of shipping other species to Manila.

The settlers from Panay, Marinduque, and Batangas are invading the forest areas. The early homsteaders, having cleared their land and being unable to keep out the grass, are using the homesteads as grazing land and are raising food crops on newly cleared forest land. The early establishment of national forests is recommended as the most effective means of keeping squatters out of the forest, or of evicting them if they enter it. In order to carry on the necessary land classification work involved in the above proposal, it will be necessary to increase the personnel of the district in order that the work may be completed within a reasonable time.

District No. 13: Headquarters, Cebu.—Provinces: Agusan, Bohol, Cebu, Leyte (western part), and Negros Oriental.

Area: 9,505.6 square miles.

Personnel: 5 rangers, 5 forest guards, and 1 clerk.

Lumbering in this district has increased because Agusan Province, which a few years ago had only a few licensees operating along the coast, now has licensees in even the most remote forests. Most of the logs from Agusan go to Manila or Cebu and the ties go to Negros and Iloilo.

Firewood continues to be in great demand and upland species, particularly ipil-ipil (*Leucaena glauca*) find a ready sale. Clear cutting is being practiced in some of the mangrove swamps and in these areas there are enough seedlings to restock the area. However, where undesirable species are left by the licensees, the better species are being crowded out. If more personnel is furnished, it will be possible to place the mangrove swamps under management and thus restore them to their former value.

About 180 kaiñgins have been inspected and complaints were filed. So far there have been 29 convictions and two acquittals. The balance, being recent cases, are still awaiting trial. It is obvious that the penalties imposed for forest destruction are not severe enough and that eviction from the land should be made a part of the sentence.

THE OFFICE OF THE WOOD EXPERT.

During this year, as in the past one, no new line of work was taken up, except the kiln-drying experiments. Two members of the wood experts staff coöperated in the Kiln-drying experiments carried on at the Q. M. C. shops and completed the last run when Messrs. Pomeroy and Connor were compelled to leave before its completion. This is discussed fully elsewhere in this report. There was a considerable increase along some lines of work; inspections of timber for local government and private use, as well as for export, were larger than in previous years and the amount of shopwork, in the way of repairs and manufacture of office furniture, etc., was also greater.

BOTANICAL AND WOOD COLLECTIONS.

As only one minor reconnaissance project was carried out during the year, the botanical collections were less than in 1919. The number of specimens received and forwarded to the Bureau of Science was 286, of which 138 were accompanied by wood specimens. Over 200 wood samples without botanical material were received and identified; of these, 185 were of sufficient interest in connection with distribution or local names, to be incorporated in the register of trade samples. In addition to information derived from such samples, a number of new local names were taken from phenological reports.

OTHER ACCESSIONS.

Twenty-one new ten-foot planks, almost all of species new to the collection, were added during the year; of a large part of these, sufficient material was obtained to work up duplicate ten-foot planks, one surfaced and one polished, and a six-foot panel. These latter serve not only as a ready demonstration set, quickly accessible from the Director's office and other departments upstairs, but also occasionally as very convenient exhibit material for local exhibits, such as are often made at Garden Days and other local school celebrations. The total number of new six-foot planks was 29, of which part were from new material and part from seasoned material in stock, to replace as far as possible the six-foot planks destroyed in the fire at the 1920 Carnival exhibit.

Sixty new floor specimens (museum logs) were received, aggregating over 30 species, almost all new to the collection. Some of these were brought in by the Palawan reconnaissance party, some collected in the course of various minor special projects, and a few were obtained in Manila from trees thrown down by the typhoon of August 31, 1920. Among these latter were the trunks of a very large raintree (*Samanea saman*), of a narra (*Pterocarpus indicus*) and of the finest specimen of *Pithcolobium inerme* in Manila.

Beside the above material, some two or three score minor products specimens, such as rattans, resins, gums, fibers, daluru, etc., were received during the year.

To the register of foreign wood specimens, 257 numbers were added, the total being now 2,103. The old method of storing the foreign specimens in separate boxes arranged by countries of origin, was becoming too cumbersome; an upright case was therefore constructed for storing them in more compact and accessible form, containing in a floor space of only one by four feet nearly 2,000 specimens. This is overflowing and a similar one will be built in January.

HAND SPECIMENS AND OTHER PROPAGANDA MATERIAL.

The system of furnishing additional material to forest stations has been continued as new stuff became available. About 350 additional specimens have been sent out and some 750 are at the present writing set aside for the same purpose, but have not been shipped out for lack of clerical help in listing, packing and mailing them.

Following is the complete record of all hand specimens issued:

Sold	2,243
Furnished to forest school	3,120
Furnished to forest stations	352
Distributed gratis or exchanged	3,443
Total	9,158

Beside the above, over 100 polished panels, 30 by 50 centimeters, were prepared in response to various special requests.

The specimens sold or distributed outside of the Islands went to the following countries: Australia, British North Borneo, China, Dutch East Indies, England, Germany, Hawaii, Spain, and the United States.

There were in stock at the end of the year duplicate hand-specimens for distribution of a little over 300 species.

SHOP WORK.

Beside the unusually large number of museum planks and logs prepared during the year, there were made in the shops the following articles of equipment: 18 office tables, 3 by 6 feet; 23 typewriter tables; foreign specimen case, 12 by 51 by 72 inches; 1 specimen case for office of Secretary of Agriculture and Natural Resources; 1 flat top desk for the Forest School; shelving in lower chamber of vault; over 10,000 hand specimens; about 50 scaling sticks for use at forest stations; a wood lathe attachment for the sawing and boring machine; two map cases for fire-proof vault; about 150 crates and packing cases for shipments to forest stations; additional racks in yard for storing and seasoning lumber and log specimens; preparation of the larger part of the material for two new counters in main corridor upstairs; and numerous minor jobs of making or repairing small office furniture, crating and packing, etc.

IDENTIFICATION, INSPECTION AND GRADING.

Wood specimens submitted for identification have been considered under botanical and wood collections; it may be remarked in this connection that only extremely rarely is any native wood specimen received nowadays that cannot be identified as to its family and genus. The work of identifying decayed wood specimens, for the purpose of ascertaining the hosts on which the various wood-destroying fungi thrive, has been continued, over 500 specimens being submitted this year by the mycologists, of which number about three fourths could be identified.

The members of the office inspected, for purposes of identification and grading (chiefly the former) the following:

		Bd. ft.
Piles	573	407,735
Ties	46,733	1,121,600
Lumber		304,685
Total		1,834,020

Beside these, numerous minor inspections of lots of building material, small shipments of logs, etc., were made in and about Manila, of which no detailed record of amounts and species were kept, the owners generally requiring only a superficial inspection and a general statement of the quality or kind of material involved.

Under the heading of identification comes also the revision of auxiliary invoices. About 12,000 such invoices are received annually, of which number the clerks in charge of checking them up send about one-third to the office of the wood expert for decisions in case of doubtful local names. In a very great majority of cases, it is possible now to place such names with a fair degree of certainty. Nevertheless, over 150 letters were sent during the year to licensees requesting wood specimens of species invoiced under names quite unknown, or at least unknown from the regions in which the invoices originated. In response to somewhat less than half of these letters, wood specimens have been sent in by licensees thus settling the status of the names in question.

COÖPERATION AND EDUCATION.

Beside the usual exhibit at the 1920 Carnival and Exposition, some eight or ten exhibits were made at garden days, provincial fairs, etc. A very successful extemporized erosion model was built at the forest school on the occasion of the Annual Agricultural Exposition of the College of Agriculture in December.

Owing to the destruction by fire of the 1920 Carnival buildings, a very large part of the best specimens of gums and resins, fibers, framed herbarium sheets, forest photographs and similar minor exhibits, was lost and it has therefore been impossible to make as representative exhibits for coöperative purposes as was possible in former years.

COLLECTING AND RECORDING DATA.

Much information continues to be obtained from the checking up of auxiliary invoices already mentioned above. Herbarium and wood specimens, though not very numerous, have in a large percentage of cases given new information about distribution and local names. Also, in revising the local names in the manuscripts for the minor forest products bulletins, it has been made a regular practice, whenever a very well-known species is discussed, about the botanical status of which there can be no possible doubt, to make a systematic canvas of the whole office force and to insert in the manuscripts all the local names so ascertained. As the office staff, technical and clerical, includes natives of about two thirds of all the provinces in the islands, it is easy to see that by consulting them all about certain very familiar plants a great deal of information about distribution and local names can be obtained. The chief value of this lies in the fact that it is often the most widely distributed and familiar domestic or semi-domestic plants that are most poorly represented in the herbarium of the Bureau of Science.

In the data secured from phenological reports there has been a great falling off, as only 75 reports, containing 374 names, were received during the year.

PUBLICATION.

The task of revising the common names in the minor forest products bulletins, up to and including Bulletin 22, was completed during this year. Whenever possible, among the various names recorded for a given species, one was selected as the "official name" of the plant, with due regard to the matter of selecting what appears to be the most widely known name and, very often, of selecting one that from its meaning is more or less descriptive of or otherwise appropriate to the plant; often the uses to which a plant is put, industrial, medicinal, etc., were the deciding factor in selecting a name. Taking into account all the publications of the Bureau, nearly 800 species have now been designated by vernacular official names. It is hardly necessary to repeat that, as far as possible, the true pronunciation of local names has been ascertained at the same time and reproduced as faithfully as may be by a simple, but fairly complete system of phonetic-spelling.

KILN-DRYING.

Early in January there arrived in Manila two men, Messers. L. K. Pomeroy and E. P. Connor, who had had extensive experience in operating the Tiemann water-spray dry kilns at the Forest Products Laboratory, Madison, Wisconsin, and had afterwards, until the end of the war, done kiln-drying work for the Army and Navy authorities in various parts of the United States.

Some time before this, the Quartermaster Corps had built a battery of three kilns in their shops which were intended to work on the water-spray system, but which, owing to lack of detailed drawing and exact specifications, had not worked properly. Arrangements were made at once for a series of coöperative tests for the benefit of the Q. M. C. and this office.

One of the kilns was remodeled under the direction of the two experts and early in March the first charge, consisting of almon (*Shorea eximia*), bagtikan (*Parashorea malaanoman*), tangile (*Shorea polysperma*), and white lauan (*Pentacme contorta*), in 1 by 12 inch boards, was put into the kiln. The average moisture content of the whole lot was 50.1 per cent. It was dried to an average moisture content of 13.8 per cent in six days. The shrinkage of seven radial and seven tangential samples was, respectively, 2.8 per cent and 4.5 per cent. In spite of the lack of various automatic controlling instruments (which there was not time to obtain from the United States) and of the men of the boiler room having shut off the steam three times during the first two days, this run was very successful. As regards some slight checks due to previous airdrying, the stock came out of the kiln in better condition than when it went in, most of the checks being completely closed up.

The second run consisted of white lauan and tangile, practically fresh from the saw. In this run it was attempted to use a more severe schedule of drying conditions, in an effort to reduce the time of drying without injuring the lumber. It was found, however, that it was too severe and the test was finally completed in the same time as the first run, six days. The white lauan was dried from 43.4 per cent to 11.1 per cent and the Tanguile from 44.6 per cent to 8.4 per cent. The condition of the lumber was not quite as good as that of Run No. 1. The drying schedule used in Run No. 1 is therefore to be recommended for the lauans.

Run No. 3 was begun immediately on the end of Run No. 2. The charge consisted of guijo (*Shorea guiso*), and yakal of several species (mostly *Shorea balangeran* and *Isoptera borneensis*, with some *Hopea* spp.; these are all woods very similar in structure and mechanical properties). The lumber was fresh from the saw, nominally 16 by 12 inches, but actually varying from ¾ to 1¼ inches. The run was begun April 29, the kiln being operated, under the supervision of the two experts, and by two members, of office of the wood expert, who had been coöperating with them in the previous runs.

Messrs. Pomeroy and Connor sailed for Europe one week after the beginning of the run and it was finished by the abovementioned members of the Bureau.

The run was completed in 19 days. The guijo was reduced from an average moisture content of 37.3 per cent to 12.9 per cent and the yakals from 31.6 per cent to 13.9 per cent. The lumber came out in very good condition; there was no splitting except a few very fine checks at the ends of some boards and only two boards near the top of the kiln were slightly warped.

On the whole, the runs showed that, from some of the softest lauans to guijo and yakal (the latter two among the most difficult of Philippine commercial woods to season), the waterspray kiln gives very rapid and extremely satisfactory results. The military authorities were so well convinced of this by the results of the first run that they immediately gave orders to remodel the remaining two kilns in the battery.

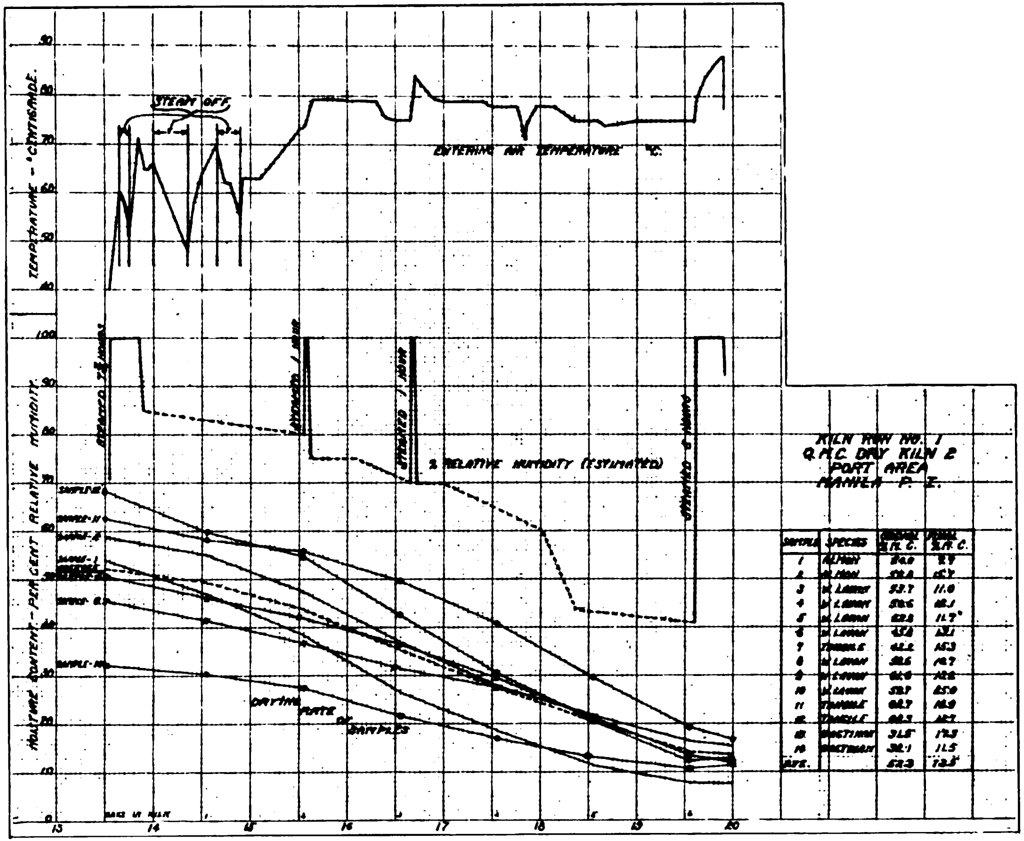
In the appendix are given diagrams and tables showing in detail the operation and results of the three runs.

DIVISION OF INVESTIGATION.

The main activity of the Division of Investigation has been centered along four lines: (1) Compilation and completion of bulletins on minor forest products; (2) the completion of the Flora of Mount Makiling; (3) Reforestation projects; and (4) Forest School.

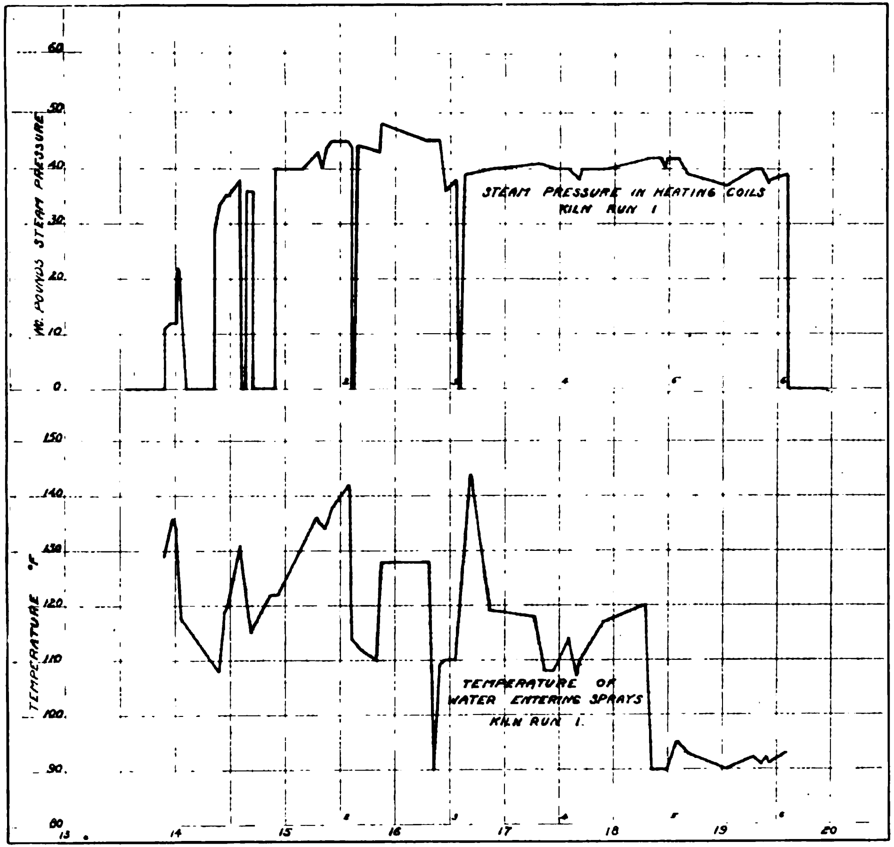
MINOR FOREST PRODUCTS BULLETINS.

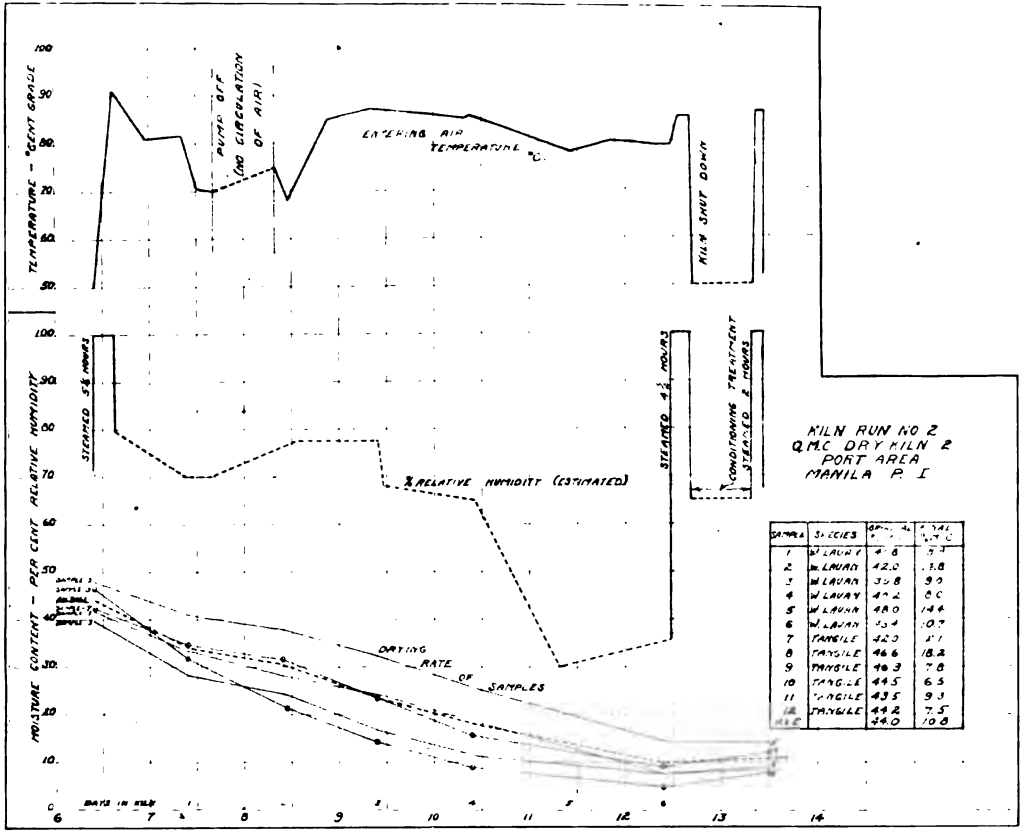
The original idea in compiling data on minor forest products was to issue as complete an account as possible of all minor forest products so arranged and indexed that any subject could be consulted either from local names, scientific names or names of products. As it was impossible to prepare the whole work at one time and as, moreover, the work naturally divided itself under certain headings, it seemed best to first issue separate



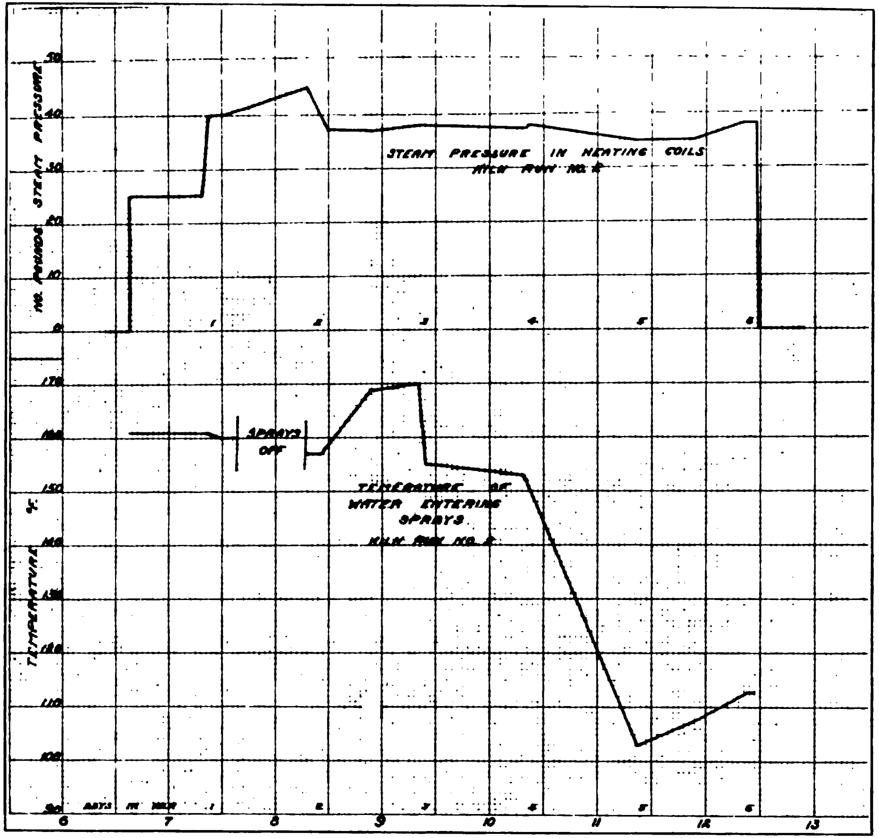
KILN RUN NO. 1
Q.M.C. DRY KILN 2
PORT AREA
MANILA P. I.

SAMPLE	SPECIES	ORIGINAL % M.C.	FINAL % M.C.
1	ALMON	54.0	8.9
2	[illegible] ALMON	58.4	15.7
3	W. LAUAN	53.7	11.0
4	W. LAUAN	58.6	18.1
5	W. LAUAN	62.8	11.7°
6	W. LAUAN	43.6	13.1
7	TANGILE	42.2	15.3
8	W. LAUAN	58.6	12.7
9	W. LAUAN	[illegible]	12.6
10	W. LAUAN	53.7	15.0
11	TANGILE	62.7	16.9
12	TANGILE	60.3	12.7
13	BAGTIKAN	31.5	17.3
14	BAGTIKAN	32.1	11.5
AVE.		52.3	13.5


STEAM PRESSURE IN HEATING COILS
KILN RUN I
TEMPERATURE OF
WATER ENTERING SPRAYS
KILN RUN I.
No. POUNDS STEAM PRESSURE
TEMPERATURE °F
60
50
40
30
20
10
0
150
140
130
120
110
100
90
80
13
14
15
16
17
18
19
20
2
3
4
5
6



SAMPLE	SPECIES	ORIGINAL M.C.	FINAL M.C.
1	W. LAUAN	[illegible]	[illegible]
2	W. LAUAN	42.0	13.8
3	W. LAUAN	39.8	9.0
4	W. LAUAN	[illegible]	8.0
5	W. LAUAN	48.0	14.4
6	W. LAUAN	[illegible]	10.7
7	TANGILE	42.0	[illegible]
8	TANGILE	46.6	18.2
9	TANGILE	40.3	7.8
10	TANGILE	44.5	6.5
11	TANGILE	43.5	9.3
12	TANGILE	44.2	7.5
AVE		44.0	10.8


NO. POUNDS STEAM PRESSURE
50
40
30
20
10
0
STEAM PRESSURE IN HEATING COILS
KILN RUN NO. 2
1
2
3
4
5
6
170
160
150
140
130
120
110
100
90
TEMPERATURE °F.
SPRAYS OFF
TEMPERATURE OF WATER ENTERING SPRAYS
KILN RUN NO. 2
DAYS IN KILN
6
7
8
9
10
11
12
13

17

bulletins dealing with various subjects and afterwards to combine these with additional material and publish the complete work. The publishing of the individual bulletins has enabled this office to make use of appropriations which were not large enough to cover the expense of the complete volume and to save the type and plates for the preparation of the complete work; also it is believed that this method will result in a considerable saving, as many people will be interested in only one section. During the year the following minor forest products bulletins have been issued:

BULLETIN 18. *Philippine Palms and Palm Products.*
BULLETIN 19. *Philippine Fiber Plants.*
BULLETIN 20. *Philippine Resins, Gums, Seed Oils, and Essential Oils.*
BULLETIN 21. *Wild Food Plants of the Philippines.*

The first volume of Bulletin 22, which is to be a complete minor forest products bulletin, has been printed. Volume 2 is in the hands of the printer and is already in page proof. Volume 3 is also in press and proof has been received for a portion of it.

SYNOPSIS OF BULLETINS ISSUED IN 1920.

BULLETIN 18. *Philippine Palms and Palm Products.*—This Bulletin contains a technical description of the palms, distribution of each species in the Philippines, a list of local names and uses of each palm. Many of these uses are of wide commercial importance, other uses are merely local and still others are important elsewhere in the East Indies, but are undeveloped in the Philippines.

Nipa (*Nipa fruticans*) furnishes thatching for houses and is the cheapest source of alcohol in the world. It grows only in tidal swamps and these are administered by the Bureau of Forestry. Extensive tracts are available on twenty-year concessions for the development of nipa swamps.

Buri (*Corypha elata*) grows in fresh water swamps and elsewhere. It furnishes fiber for certain kinds of hats. The petioles of the leaves are locally used for logging cables and tugs for carabao harness. It also produces sugar, which is so great a delicacy that but little reaches the Manila market.

Other sugar producing palms, while abundant, are scarcely utilized. The kaong or cabo negro palm (*Arenga pinnata*) is one of these. It is highly esteemed because of a black fiber which makes durable ropes for use in salt water. This fiber when used as roofing is more durable than cheap galvanized iron.

These palms and many others deserve to be widely cultivated on land not suited for agricultural crops.

BULLETIN 19. *Philippine Fiber Plants.*—There are a vast number of trees and shrubs producing fibers which are used locally for ropes. The fiber from one shrub, salago (*Wikstroemia* spp.) is highly esteemed in Japan for the excellent quality of bank note paper that it produces. There is no reason why this shurb should not be planted on a large scale on the grass covered hills of the Philippines. Other shrubs and trees have sufficient value to warrant experimental plantations being made.

BULLETIN 20. *Philippine Resins, Gums, Seed Oils, and Essential Oils.*—The resins of the Philippines come from a number of trees. Almaciga or Manila copal comes from a coniferous tree, *Aghathis alba,* and is of great commercial importance, as is also the "balau" from apitong (*Dipterocarpus* spp.) and "brea," or "Manila elemi," from the pili (*Canarium* spp.). In addition to these, various other dipterocarps contain resin and there is no reason why these trees should not be tapped a year or two ahead of logging operations.

The oil nuts of the Philippines had extensive local use before petroleum was introduced and now that the price of the petroleum is so high the villagers in remote places are turning to their ancient oil supply.

The lumbang oil industry is regaining its former importance. Since Spanish times the lumbang groves (*Aleurites moluccana*) of Cavite had been neglected, but within the last two years the demand for nuts has led to further planting of this tree.

Among the essential oils, ilang-ilang (*Canangium odoratum* Baill.) has long been exported and there is no reason why a very valuable oil should not be extracted from Aroma (*Acacia farnesiana*) which grows best in dry situations, especially on waste grass (kogon) covered hillsides.

BULLETIN 21. *Wild Food Plants of the Philippines.*—It has been said that the Filipinos had a greater variety of vegetable food than any other people. They not only have the cultivated vegetables, but they also have a large number of wild plants to draw upon. It is proverbial that a Filipino can go into any thicket and pull out a vine with which to tie up a bundle, replace a broken harness or repair a fence.

The same might be said of food plants. The leaves used for flavoring, the blossoms and young shoots that serve as salad and greens, the tubers, bulbs and roots, the ferns and fungi, the buds and pith of palms, to say nothing of wild fruits, all furnish appetizing dishes. This bulletin is a compilation of such plants and was published in order that the use of such plants should become more general and also that unrecorded uses might be noted for possible future publications.

THE FLORA OF MOUNT MAKILING.

This work has been completed, and if sufficient funds are available, it is hoped to have it printed next year. The Flora of Mount Makiling will contain keys to and descriptions of the woody plants in the Mount Makiling region. It will be a great help to the Forest School, which has been greatly handicapped by the lack of a publication which would enable the students to identify the woody plants of the region.

DENDROLOGY.

Efforts are being made to secure as complete a herbarium as possible for the Division to aid in identifications and for use in the class in Dendrology.

The great need now is a publication describing all the important trees of the Philippine Islands with plates showing the foliage, flower and fruit of at least one species in each genus. This should be a revision of Whitford's Bulletin 10.

SILVICULTURE.

No extensive reforestation was carried on this year due to the lack of personnel and funds. However, the several projects already started have been continued.

Cebu Reforestation.—This project was begun in 1916. The area lies within the Talisay-Minglanilla Estate and comprises an area of 4,095 hectares. Practically no work has been done this year due to the lack of funds.

Considerable Ipil-ipil (*Leucaena glauca*) seed has been broadcasted and also some Lumbang (*Aleurites moluccana*) and Bagilumbang (*A. trisperma*). Seedlings of Teak (*Tectona grandis*), Narra (*Pterocarpus* spp.), Langil (*Albizzia lebbeck*), Bitaog (*Calophyllum inophyllum*), and Banalo (*Thespesia populnea*) have been planted.

Taken as a whole, the planting on this project has been a success. There has been a decided change in the attitude of the squatters on the estate toward the Bureau and its policies. At first they were hostile, but now the forest officers find little difficulty in dealing with them and securing their coöperation.

The following is a summary of the work done:

Total area planted not needing replacement	hectares	2,545
Total expenses, June 1916 to December 1919		₱10,000
Amount of Ipil-ipil seed broadcasted	liters	35,260

Amount of Ipil-ipil seedlings planted		115,470
Number of Bagilumbang seeds sown		802,550
Number of forest tree seedlings planted		14,800
Amount of boundary lines cleaned	kilometers	23.5
Amount of boundary lines planted		20.4
Amount of horse trail constructed	kilometers	0.915
Amount of foot trail constructed	kilometers	3.114

Ilocos Reforestation.—The reforestation work in the Ilocos provinces was inspected in August. The various projects are scattered and the great difficulty in securing quick results lies in the fact that the forest officer in charge finds trouble in properly supervising the work. This is a matter of more personnel.

The whole reforestation project in this region depends on coöperation with the inhabitants and on the protection of the areas from grazing and fire. Considerable educational and propaganda work is essential to make this a success.

Mount Arayat Reforestation.—Mount Arayat is a solitary volcanic peak rising 1,000 meters above the plains of Pampanga Province. The base of the mountain has been cleared off and brush, grass and patches of temporary cultivation occupy this region. Such land as can be placed under permanent cultivation has been homesteaded and permits are being issued to villagers in the vicinity to clear off brush, sell the firewood, raise a crop of upland rice and then plant seeds of firewood or timber producing trees. Early attempts in carrying out this plan failed, because the occupants of the land had been instigated to cook the seeds before planting them. Most of the people have a better understanding of the subject now and the areas destined for firewood production are gradually being replanted. The chief handicap is money with which to purchase seed.

The forest of Mount Arayat needs a long rest. In fact, it needs reforestation, because all of the best species have been removed and scarcely any seedlings are left. Duñgon the most sought after tree on the mountain, has disappeared and the same is true of guijo and other desirable or popular lumber trees which at one time were abundant. The only remedy is to plant desirable species, but that will take money for seed and labor. Much of the work can be done with the aid of temporary cultivators of the soil, but at best this method will be slow and irregular, because only the best patches will be reforested.

Corregidor Island Reforestation.—Upon the request of the Military authorities, two foresters were sent to Corregidor Island to inspect it and report upon the possibility of planting the bare and grassy spots upon the island. This is essentially an

Ipil-ipil proposition in the beginning, to be followed later by underplanting with timber trees. Ipil-ipil and Madre-cacao (*Gliricidia sepium*) are recommended for nurse crops with Molave (*Vitex parviflora*), Supa (*Sindora supa*), Malaruhat (*Eugenia* spp.), Narra (*Pterocarpus* spp.), Lanete (*Wrightia laniti*, Tindalo (*Pahudia rhomboidea*), Teak (*Tectona grandis*) and Raintree (*Samanea saman*), for final stand of timber. Considerable Ipil-ipil seed was gathered by the garrison at Camp Eldridge to commence this work.

Cotabato Reforestation.—This reforestation has been requested by the provincial authorities in order to eliminate the locust breeding grounds. Ipil-ipil planted in the grass lands will secure good results. Some Ipil-ipil seed has already been shipped to Cotabato, but very little work will be done in connection with this project until 1921.

Mount Makiling Reforestation (*a*) *Paliparan area.*—This area lies just back of the Military reservation (Camp Eldridge). The work was started about five years ago and the purpose of this project was to plant up grass areas, especially land occupied by kogon. The area was inspected in January and the planting found to be successful. Ipil-ipil was the main species used. It has successfully occupied the area and in two or three years the ground will be entirely covered with Ipil-ipil and the kogon crowded out. This project was more in the nature of an experiment and it was learned that the best method to use was, first, to burn over the area in the dry season to get rid of the grass and then to broadcast Ipil-ipil seed. Fire must then be kept out for at least two or three years. In two years the Ipil-ipil had reached a height of one meter. During the third year it grew beyond the kogon and if then injured by fire, the roots sent out new shoots. During the first two years, however, the seedlings will be killed if a grass fire occurs. It requires about five years for a broadcasted area to lose its kogon character. After this time a light fire might be beneficial, as it destroys the dense ground cover and Ipil-ipil seed falling from the trees will be able to germinate. Some Narra (*Pterocarpus* sp.) cuttings were also planted, but did not seem to be successful.

(*l*) *Kaiñgin Reforestation.*—This reforestation is the result of a plan inaugurated, in coöperation with the District Forester, to control kaiñgins by requiring the occupant of the land to plant forest trees. Plantings have been made by 70 kaiñgin-makers on the north side of Mount Makiling and principally in the Calamba Estate Addition. This involves an area over 37 hectares and about 9,000 trees have been set out, including the following species: Akleng-parang (*Albizzia procera*), Bagilumbang (*Aleurites trisperma*), Kaong or Cabo negro (*Arenga pinnata*), Lumbang (*Aleurites moluccana*), Malaruhat (*Eugenia* spp.), Pugahan (*Caryota cumingii*) and Teak (*Tectona grandis*).

These areas are inspected from time to time, but the experiment has not gone far enough to justify making any conclusions.

Summary of Reforestoration.—The reforestoration work so far carried on has shown that Ipil-pil is the best species to use in most cases and especially in grass areas. It occupies the land quickly, serves as a nurse crop and in five years furnishes timber of a size sufficient for firewood. Experience has shown that fire must be kept out of a planted area for at least two or three years, otherwise no results of any value will be secured.

Reforestation is of first importance in forestry practice in the Philippine Islands and sufficient funds should be appropriated to carry on this most necessary work.

Nursery.—The nursery was moved from the old site to a site nearer the school, thus making it more accessible to the students and easier of administration. The reason for this is that it was formerly located on land belonging to the College of Agriculture, whereas today it is within the boundary of the Makiling Forest Reserve. Hectares D and F were cleared. Hectare D contains the ornamental plant beds, the nursery house, transplant beds, hot beds, etc., while Hectare F contains the student nurseries. The unoccupied area has been planted with pineapple and kamoteng-kahoy to keep out the grass and at the same time furnish the students with part of their food supply.

The cost of establishing the nursery up to date was approximately ₱1,450, including the following operations: Clearing, terracing, planting, upkeep and improvement.

The following materials is in the nursery at present:

Timber species	15,860
Palms	11,520
Cycads	800
Vines	1,640
Economic and ornamental shrubs and herbs	20,800
Total	50,620

The above figures do not include the student nurseries.

The new nursery will require a force of at least eight men to keep it in proper condition. It is one of the show spots for visitors at the Forest School. It is our aim to propagate all species of plants here that can be grown in the Philippine Islands. The greatest need at present is the installation of a water system to enable us to carry on the work during the dry season. This will cost approximately ₱600, as over 500 meters of pipe will be required as well as the necessary fittings. More space is available in case it is desired to increase the size of the nursery. This was not possible with the former location. A deep ravine runs through the center of Hectare D; by damming and making an artificial pond here, we will be able to raise aquatic vegetation. The nursery is readily accessible from several points and trails have been built to it from several directions as well as through the various portions of the area so that all points can be reached.

Arboretum.—The arboretum was also transferred from its original site near the old nursery to a site adjacent to the new nursery. It occupies the area between the nursery and Mulauin Creek. All trees that could be moved were taken up and transferred and only the large ones were left in their original location. New plantings were made of species not represented and in a few years the new arboretum will show a large number of species both native and exotic. Cutting were made of all the species of bamboos in the old arboretum and transferred to the new site. In addition, the bamboo plantation just below the Forest School was cleaned so that it is now readily accessible.

The cost of establishing the new arboretum was about ₱560, including clearing, transplanting, upkeep and improvement.

The arboretum now contains 610 plants as follows:

Timber and fruit trees	243
Shrubs and herbs	292
Vines	45
Palms	30

Reproduction Studies.—Due to the lack of personnel and available time, the reproduction plots in the cut-over areas of the Cadwallader-Gibson Lumber Company at Limay, Bataan, established in 1913, were not inspected this year. They will be visited in January, 1921 and it is hoped that these figures can soon be compiled into a report.

Silvical Leaflets.—In connection with the class work in Silviculture, fifteen new silvical leaflets were added to the files, thus making the total number 231. These leaflets contain valuable information regarding the characteristics and habits of Philippine timber trees and will eventually form the basis for a publication on silviculture.

Seed Collection and Distribution.—Considerable seed of various tree species was collected by the students and laborers and some seed was bought. In addition small quantities were received which had been collected by the field force of the Bureau, but these did not suffice to supply the demands for seeds for planting purposes. Ipil-ipil, Lumbang, and Bagilumbang were obtained in quantity, but only small amounts of other desirable species were secured. During 1921 it is hoped to interest the field force to such an extent that we will be able to secure a sufficient amount of all species for which there is a demand.

The following quantities of tree seeds were distributed during the year:

Kind.	Destination.	Quantity (liters.)
Molave (*Vitex parviflora*)	Vigan, Ilocos Sur	3½
Narra (*Pterocarpus* sp.) and Lumbang (*Aleurites moluccana*)	New Washington, Capiz	14½
Ipil-ipil (*Leucaena glauca*)	Director of Forestry (Reforestation work)	600
Ipil-ipil	Aringay, La Union	250
Ipil-ipil	Aparri, Cagayan	60
Lumbang	Moron, Bataan	60
Madre-cacao (*Gliricidia sepium*)	Catarman, Samar	½
Anahau (*Livistona rotundifolia*)	City Nursery, Manila	20
	Total	1,008½

Plant Accessions and Distribution.—Over 120 species mostly ornamental, were secured for the Forest Nursery from Cementerio del Norte through the coöperation of the City Nurseryman of Manila. These species were not previously represented in our nursery and they are at present being propagated to secure material for distribution.

During the year about 8,200 plants, including timber trees, ornamental trees and shrubs, were distributed from our nursery as follows:

Destination.	Number.
Laguna Schools (Arbor Day)	785
Camp Stotsenburg	5,000
Camp Eldridge	70
British North Borneo (Forest Dept.)	580
Manila (various places)	900
City Nursery, Manila	450
San Fernando, Pampanga	200
Miscellaneous	215

The increase in the size of the nursery and the extensive planting planned will enable us to take care of any reasonable demand in the future.

Plantations.—No new areas were added to the plantations during the year due to the scarcity of labor. The present area of the plantations is 83¾ hectares. Some of the hectares established in the last few years are chocked with grass and are badly in need of cleaning, but it was impossible to have this done as the labor could not be secured, although funds were available for this work.

Cost Records.—The cost records have been kept up-to-date and figures are available, showing the cost of planting and reforestation.

Studies.—In addition to the studies mentioned under Minor Products, the Madre-cacao (*Gliricidia sepium*) planting at the Alabang Stock Farm was inspected by a ranger of this Division.

UTILIZATION.

Lumbering.—No intensive study was made in this subject this year. It is hoped in time to have all the more important logging and milling operations in the islands visited and studied. Cost figures especially are desired and in time this work would make the basis of a publication on "Lumbering in the Philippine Islands." This work can be carried out by this Division in coöperation with the Division of Sawmills and Utilization.

Minor Products (*a*) *Firewood.*—Studies were conducted by members of the division on the solid contents of a cubic meter of stacked Ipil-ipil firewood. This was done by the xylometric method and the results showed that a cubic meter contained approximately 45 per cent of solid wood. This fact is of interest and value, as studies of the same sort conducted by Raphael Zon in the United States showed an average of 75 per cent. (See Graves' Forest Mensuration, page 106.)

(*b*) *Other Products.*—The rattan forest near Cavinte, Laguna, was visited and valuation plots laid out. This is a license area and the licensee has been planting rattan. It was found that the planting of rattans for commercial purposes is practical.

The planting of Lumbang, Bagilumbang, and Gogo (*Entada phaseoloides*) in southwestern Cavite were also visited and studied and much information of value was obtained. The results of this study will be presented in a separate report.

A study of the pandan industry at Santa Cruz, Laguna, was also made.

ENGINEERING.

A comprehensive plan of engineering work has been laid out by this Division. This includes the following:

(*a*) Making a new map of the Mount Makiling Forest Reserve, showing topography, vegetative features, improvement work, etc.

(*b*) Establishment of bench marks in the plantations and on the mountain.

(*c*) Determination of the elevation of the peaks of Mount Makiling. This is to be done by differential leveling using a wye level.

(*d*) The establishment of several triangulation stations at salient points about the reserve.

(*e*) The determination of a meridian to aid the classes in surveying.

Part of this work has already been started and bench marks were set at the corners of all intersecting rides in the plantations.

The levels up the mountain have been run to the top of the first peak, the elevation of which is 1071.7 meters or approximately 3,515 feet. Bench marks have been set along the Summit trail. This trail is also equipped with guide signs and kilometer and half-kilometer posts.

A new patrol trail to the Paliparan area was laid out and is almost completed. In addition the Summit, Mud Spring and Puting-lupa trails were repaired, thus making the north side of the mountain more accessible to visitors. Several new trails are projected for 1921.

WOOD TECHNOLOGY.

(*a*) *Durability tests.*—All the woods in the durability test were taken up and examined and replaced again in the ground. This was done in September and a separate report made concerning the results.

(*b*) *Wood preservation.*—No work was done in this line due to lack of equipment and supplies. However, after the water distillation plant is erected it is hoped to install an open-tank pressure process in connection with the boiler, where woods can be treated and the results of this treatment studied. This will be of importance to wood users, especially those using ties and poles.

(*c*) *Other work.*—It is planned to increase the number of microscopic slides of Philippine woods. About 75 have been prepared, but the work has been halted due to the lack of a suitable microtome and the necessary stains. However, this equipment has been secured and the work will be resumed in 1921.

FOREST MANAGEMENT (INCLUDING MENSURATION).

(*a*) *Growth studies.*—The yearly measurement of about 590 trees comprising the eight principal species found in the Makiling Forest Reserve was taken in May. This work was started in 1913 and valuable data have already been obtained during this time, especially figures showing the rate of growth. The measurement of every tree in the pure stand of Bagtikan (*Parashorea malaanonan*) was also continued. These, together with other growth figures taken in the plantations and elsewhere, should be available for publication in a year or so. Definite conclusions can now be drawn from these figures.

The experiment on the growth of unit areas on Mount Makiling, which was started in 1917, was also continued this year. Besides giving figures on the yield that can be expected on definite areas, this experiment will illustrate the effect of improvement cuttings on the forest.

The semi-yearly measurements of the trees in the plantations were also taken. However, it is proposed in 1921 to take these measurements only once a year due to the large size of most of the trees.

(*b*) *Working plans.*—In connection with the class in forest management, the students prepared a working plan report for the area located on Balong-Bulo, a small hill situated about two kilometers east of the Forest School and adjoining the College of Agriculture Experiment Station.

Beginning in 1921 it is planned to make a complete working plan for the Mount Makiling Forest Reserve, with a view to putting it under intensive forest management. This will require a division of the forest into blocks and an intensive reconnaissance of each block. It is expected to do a considerable part of this work in connection with the class work in forest management and engineering.

GAME.

The protection of game is rapidly becoming a feature of forestry in the United States. In Europe it has been closely allied with the profession for many generations and European foresters are well versed in this phase of the work.

Mount Makiling has a rich and varied wild life and is the only region close to Manila where these animals can be readily seen and studied by visiting scientists. There is considerable hunting on the mountain, especially of deer and wild pig. Both are rapidly becoming scarce and some measures should be taken to protect them for a time at least. The abundance of snakes in this region is said to be due to the scarcity of wild pigs. Most of the hunting is done by natives and when they can not find deer or pig, they shoot birds, which is against the law. Therefore it is recommended that some measures be taken to stop hunting. Deer should be absolutely protected and the hunting of wild pig should be prohibited for at least two years until these animals can multiply sufficiently. A longer period than this is unnecessary and would result in the pigs becoming a nuisance.

Game protection of course involves police power and this should be granted to the foresters and rangers who are stationed here. Two or three responsible forest guards should also be given this authority.

THE WORK IN BAGUIO.

The district forester at Baguio is not only concerned with the usual administrative work of a district forest officer, but in addition is carrying on work in forest management, forest protection and reforestation. He also handles all the parks and nursery work for Baguio and vicinity.

The forest upon the public land within the Baguio Civil Reservation are being managed intensively in order to utilize to the utmost the scanty supply of timber and firewood and at the same time to retain the beauty of the pine forests for which Baguio is noted.

The miners were permitted to secure timber from other forests than those set aside for the mines in order to facilitate their operations.

All trees needed for local use or for fuel were selected for felling by a forest officer and the Christmas trees for the local trade and for the Manila market were secured in areas where their removal would do no damage.

Because of the short dry season only one serious fire occurred, but even so nearly 20,000 small trees were killed. Because of the lack of funds, no progress has been made in solving the fire problem except in and about Baguio. The number of cases of forest destruction by squatters has been reduced to almost nothing near Baguio.

The reforestation projects at the hydroelectric plant and on the head waters of Antamok Creek were inspected frequently and the results are satisfactory. The young growth however is not out of danger from fires.

The work in Baguio included the maintenance of the forest nursery and carrying on the numerous planting projects.

The pine trees have for several years produced no seed and therefore all work on pine reforestation has come to an end except for some plantings of forest grown seedlings.

The camphor seed ordered from Japan failed to arrive, but other seeds from Japan have done well. Among those imported during 1920 are the following: *Scirpus lacustris, Castanea shibaguri, Castanea japonica, Thea sinensis, Juglans cordiformis, Zante currant, Salix multinervis, Acer atropurpureum* and *Umbellularia californica.* Among seeds received from California were the following: *Eucalyptus globulus, robusta, tereticornis, viminalis, etuartiana,* and *Chrysophyllum oliviforme.* During the year, 2,320 plants were distributed to the city and to individuals.

For private parties	728
Roads and drives	567
City parks	1,025

There are on hand 4,000 trees, 12,000 shrubs and trees and 3,000 herbacious flowering plants for use in 1921. For reforestation work, 14,570 plants were used, but most of these were intended to cover the ground and thus by killing the grass reduce the fire hazard. As a matter of fact, comparatively little tree planting has been done. The District Forester in coöperation with the Trinidad Agricultural School planted up a steep hillside containing 2.2 hectares.

Small plants were transferred from the nursery to experimental plantations, among these being 134 camphor trees.

The trees on the growth plots were measured and a new plot was laid out in the reforestation area at the Trinidad Agricultural School.

The work at the nursery is under a serious handicap because so much time is required to water the plants during the dry season. At present the water in Pacdacal Creek after rains goes to waste. Much of it could be used in the nursery if several catch basins were constructed. This work can be done at a reasonable cost and will greatly reduce nursery expenses.

An experiment was made with guano from caves in the Philippines and, as satisfactory results were obtained, it is probable that guano will be used instead of imported fertilizers.

Roads and parks.—The City of Baguio coöperated in fire protection, the city laborers being available to fight fires within the city limits. The city appropriated ₱4,500 for the maintenance of parks and for tree planting.

Burnham park was prepared as a landing place for aviators and the plants which had suffered from standing water were planted at higher elevations.

Wright park was cleaned up and the newly set out ornamentals were watered and cultivated during the dry season. It is expected that this park will require less attention in the future.

The grass in the City Cemetery was kept cut and where necessary trees were set out.

Forbes park was further beautified and a grove was fitted out for picnic parties; a wooden dam has made a swimming pool and it is evident that a concrete dam costing ₱1,000, will make a considerable pond suitable for boating and fishing.

Roadside trees were set out and looked after and special care was taken to protect young trees from damage by storms. Foot paths were constructed and several bridges were replaced or repaired and concrete or stone culverts were made where necessary.

THE FOREST SCHOOL.

The Forest School is a branch of the University of the Philippines, but, as one of its main objects is to fit young men for work in the Bureau of Forestry, the administration and maintenance of the school is assumed by this Bureau.

The Bureau of Forestry offers scholarships each year to such persons as are qualified to take the work at the Forest School. The students are selected from among energetic forest guards and from students of high schools or schools of similar rank.

The senior class of 1920 contained three Chinese students supported by a special fund in China. There were seventeen who graduated and were admitted to the Bureau of Forestry.

The class of 1922 was enrolled during the first week of April with thirty-four members. Of these, four were holding scholarships from the British North Borneo government. The number of students in this class is twenty-six at present.

The courses in botany and trigonometry were formerly given at the College of Agriculture, but as the two schools are over a kilometer apart it was decided to give all the work at the Forest School and thus save the time of the students.

The school was handicapped by the transfer of one forester to other work in the Bureau and by the resignation of two experienced rangers. A forester from the United States was assigned to the school and two field men were detailed to the school. All of these have done well.

During the year, a number of improvements were made. The arboretum and forest nursery were transferred to a site near the present school, where there was more room for expansion. Two cottages were erected and are occupied. An electric light plant has been installed, to the great benefit of the school and students.

The Bureau of Forestry telephone line was extended to the school, thus giving direct connection with the several departments of the College of Agriculture and College of Veterinary Science and also with Los Baños.

A water distillation plant is in process of erection and the trails to points of interest have been improved.

The collection of birds indigenous to the school was lost in the Carnival fire of 1920 and an effort should be made to replace the collection, as it was one of the attractions of the school. The other natural history collections are being increased by the students. Over two-thirds of the snakes found in this region have already been identified and placed on view and the insects and fish are receiving attention.

The library has been catalogued and only miscellaneous publications remain to be classified. All books and pamphlets are easily accessible to the students. The work of preparing a subject index has been commenced.

The students have been encouraged to raise their own vegetables and in addition they are also raising pigs for their own use. Their general health has been good, but four different students lost considerable time because of sickness and finally went to Manila for treatment because there are no hospital facilities for the three schools at Los Baños.

The students have taken a keen interest in forestry and whenever excursions came to the campus, the Forest School students did their part in showing the points of interest and in explaining the essentials of forestry to the visitors.

The course at the school has been revised with a view to making it as practical as possible. Furthermore, in order to secure the best possible students, members of the faculty and other forest officers visited every high school and gave talks regarding forestry as a profession.

The senior class has made two trips. One was to Mount Lobo, where the students applied their instruction in a practical manner. The other trip was to a mangrove swamp, which the class studied and mapped. Both of these trips were of great benefit to the students and the data secured will be of use to the Bureau of Forestry.

DIVISION OF SAWMILLS AND UTILIZATION.

PERSONNEL.

The large demand for lumber throughout the Philippines during the past year, together with the exceptionally high prices prevailing, have led to a general increase in the production of existing mills, together with considerable activity among licensees in establishing mills on areas formerly devoted to logging work only. While the necessity of withdrawing all rangers that could be spared for assignment to land classification work, has prevented the increase in the ranger personnel of this Division, which would have been desirable, the system of training all the rangers graduated from the Forest School which was adopted two years ago has permitted the increase in the number of stations at which a better supervision of the scaling of logs for sawmill licensees could be carried on. With these rangers available at the different stations throughout the Islands, and the increase in the number of guard-scalers who have been appointed during the past year, the scaling work is gradually being brought to a point of efficiency which will prove more satisfactory to both the Government and the licensees in the proper measurement and manifesting of timber.

However, the solution of this problem has not as yet been reached as the Bureau has met with a very serious handicap in the matter of holding the men who have been trained as guard-scalers and who have proved efficient in the work. The training which they receive in the scaling and identification of Philippine timber and in tallying and checking lumber makes them valuable to the lumber companies, so that in several cases the Bureau has lost efficient guards through their resigning to accept more salary as checkers and scalers for the lumber companies. The importance of this scaling work, which will constantly increase in volume with the developement of the sawmill industry in the Philippines, and the necessity of holding the rangers, with their greater technical education, free for the other administrative and technical work carried on by the Bureau, makes it very important that a corps of guard-scalers be organized on a permanent Civil Service basis with salary grades and vacation privileges which will make these positions attractive to the right class of men and which will compare favorably with the salaries offered them by the lumber companies as soon as they have received their training.

At the close of this year there are 21 rangers and 24 guard-scalers doing scaling work throughout the various districts, while the installation of new mills and the increase in production of some of the old mills makes the appointment and training of 6 to 8 new guards within the next few months very necessary.

While the principle of scaling timber in the round adopted in 1915 by Act No. 2451 of the Philippine Legislature has been generally accepted and the scaling of logs by Government scalers at the larger mills has been carried on with very few complaints during the past two or three years, the practical application of this primary business principle still leaves much to be desired, owing to the small personnel provided for carrying on the work and the comparatively low salaries paid the men employed.

The passage of Act No. 2451 was sought to protect the interest of the Government in securing the full value of the timber sold to licensees as compared with the large losses which previously were incurred when paying on the sawn product on account of the wasteful methods practiced in many of the mills. However, this law likewise placed an obligation on the Government which has not been met save in the case of larger sawmills. This obligation is contained in the provision that licensees measuring and manifesting their own logs must record and pay for full measurements and deductions for defects may only be made by the Director of Forestry or his authorized agent. As practically all timber contains more or less defects, the present shortage of scaling personnel is as unfair to the small licensees who must measure and manifest their own timber as the former system was to the Government and has simply led to false manifests in large numbers of cases where the regulations of the Bureau of Internal Revenue and the administrative personnel are unable to cope with the situation.

The most fundamental of business principles require that the Government should provide its personal representative for the supervision of the logging operations and the measurement of timber sold, both in justice to itself and to the licensee.

GRADING.

The importance of introducing a generally accepted and official set of grading rules for lumber and timber and of training a corps of men competent to perform this class of work has been repeatedly mentioned in previous annual reports, and can not be too strongly urged upon lumber manufacturers and dealers.

The exportation of lumber during 1920 has considerably increased and the future development of the industry depends very largely on the development of an export market, which in turn depends on the shipment of standard, reliable grades of lumber. An indication of the damage which may be done to the export trade in lumber is contained in the reports published in the local press at the close of the year of shipments of Philippine lumber lying on the docks in San Francisco and Seattle with no buyers because of its poor condition and in unofficial inspections. by members of this Bureau, of shipments to the United States in which six or more lower group species of poor quality were substituted in part for the two species specified by the purchaser. The continuation of such practices as this can only result in the establishment of a bad name for Philippine lumber in the countries to which it is shipped, which will require much time and trouble to overcome, and it is again urgently recommended that the local lumbermen combine to establish definite rules under which all foreign shipments of lumber shall be made.

The further training of Government inspectors has had to be abandoned during the past year and there is no prospect at present for resuming it during the coming year, owing to the large amount of pending work and the small personnel provided. Numerous requests for inspections have been complied with by members of the Office of the Wood Expert, but such inspections have been necessarily confined almost exclusively to identification of species and a general statement of the merchantable character of the lumber, with no effort to grade as to quality as is the common practice in the United States.

LUMBERING.

The continued growth of the local lumber trade, together with the increase in the export market during the past year. had produced, until the general cessation in all lines caused by the financial stringency of the last few months of the year, almost unprecedented prices for lumber and a demand for license areas greater than the forest areas commercially available could accommodate. This has in turn greatly stimulated the interest of small licensees in the installation of sawmills, so that all machinery available locally has been put to work and new mills ordered from the United States by licensees anxious to secure their share of the active and profitable market which has prevailed during the greater part of the year. Newly installed mills have started operations on the areas of the following licensees; Zambales Lumber Company, Northern Luzon Lumber Company, Ruiz y Rementeria, Flecha Point Lumber Company, W. L. Lamb, A. Bleivel, I. Rosales and N. O. del Pilar, while the old Taba Bay Sawmill resumed operations in February under the direction of the Hercules Lumber Co.

Sawmills are also ordered or under installation by the Agusan Timber Company, Rosenstock, Wrentmore and Reynolds, P. Chavez, E. A. Gebert, F. L. Evangelista, Albert Bryan, Lucanin Plantation Co. and licensees in Bagac, Bataan and Subic, Zambales.

While it is believed that the reaction in the lumber market being experienced during the last two months of the year is entirely due to a temporary fluctuation resulting from the financial crisis, and that the timber market will return to approximately its previous activity and level of prices, it is believed that the large number of licensees, unfamiliar with efficient methods of logging and sawmill operation, who are rushing into the business without competent managers or sufficient capital resources, will cause many failures as soon as the prevailing heavy demand is taken care of and the purchasers become more particular and exacting in their demands for a better grade of lumber.

The shortage of personnel already noted has made it impossible to keep up to date records of the production of all the sawmills distinct from the production of the smaller licensees operating without mills, while reports requested from the millmen themselves are so delayed and incomplete as to make it impossible to include the data in this report.

Reports available from 18 companies show the following production figures:

Year.	Log scale.	Mill tally.	Sales.	Forest charges.
	Cubic meter.	*Cubic meter.*	*Cubic meter.*	*Pesos.*
1919	285,729.82	202,066.81	191,890.07	248,563.87
1920	306,837.15	215,515.54	216,584.78	262,747.78

While production as a whole has increased during 1920, this increase has been largely due to the preparedness of a few of the largest mills and to the increased activities of the smaller mills induced by the boom in the lumber business. Many of the older mills however have shown a sharp decline in the amount cut during 1920 as compared with the previous year, due to a number of reasons. The large amount of coast line found in the Philippines, much of which is forested, has until the last few years permitted a large amount of logging with the simplest possible methods, which created an unwarranted dependence on this type of logging by many operators, the majority of whom were almost totally unfamiliar with modern methods of animal and mechanical logging and who were very loath to make the investment necessary for the installation of such methods as would permit the development of areas further in from the coast, which could not be profitably reached by the simple animal and hand logging methods in use. With the general improvement in the lumber market which started in 1916, came also the large increase in the cost of all machinery and supplies, which brought further hesitation on the part of these mill owners to invest in the machinery necessary for the further development of their areas, with the result that during the past year the majority of these licensees have not only been unable to increase their output, but in the majority of cases have fallen behind their production of previous years owing to inability to supply their mills with sufficient logs. Decreases in the log scale at these mills have run as high as 1,200 to 4,000 cubic meters for the year.

LOCAL MARKETS.

As noted in the annual reports for the past three years, the large amount of local development work in sugar, coconut oil and other industries and in public works development has furnished a very active local market for timber and has absorbed from 85 per cent to 90 per cent of the total production in addition to imports slightly in excess of one half the amount exported.

The following tables made up from reports receive from the mills at which forest officers are stationed, shows by principal species and ports, the distribution of the lumber sold by the larger and more active companies operating in the Philippines.

Lumber shipment by seventeen lumber companies, January 1 to December 31, 1919.

Destination.	Red Lauan and Tangile.	White Lauan.	Apitong.	Guijo.	Manga-chapuy.	Lumbayao.	Yacal.	Palosapis.	Miscellaneous.				Total.
									First group.	Second group.	Third group.	Fourth group.	
United States....	1,826,222	1,951,969	763	....	....	....	....	....	....	....	....	....	3,778,954
Hongkong.......	....	447,822	....	....	....	....	....	....	3,025	....	....	....	450,847
Shanghai........	882,331	1,125,848	75,516	....	....	27,354	....	....	....	....	....	69,633	2,180,682
Manila..........	3,346,899	13,793,392	7,361,583	1,675,848	65,842	1,299,844	1,261,086	750,774	....	....	....	5,204,558	34,759,821
Luzon Ports.....	6,216	4,635	168,981	18,385	....	....	15,786	22,248	....	....	....	61,949	298,150
Cebu...........	825,920	1,661,958	1,130,530	172,487	24,713	264,931	184,513	....	....	....	....	496,192	4,761,244
Iloilo..........	196,352	795,308	143,508	15,013	3,743	22,474	1,295	....	....	....	....	46,261	1,223,954
Visayan Ports....	659,477	143,781	40,771	5,899	....	15,958	40,080	....	....	....	....	3,807,206	4,718,172
Zamboanga......	26,133	640,027	258,845	178,570	11,454	586,416	197,781	....	....	....	....	172,628	2,071,854
Davao..........	....	176,186	50,136	90,072	2,167	96,130	53,803	....	....	....	....	198,846	667,340
Mindanao and Sulu Ports.....	245,205	1,899,799	570,120	147,110	21,913	335,567	139,021	....	....	....	....	189,123	2,997,858
Unclassified Ports.	7,610,221	8,784,248	2,082,216	....	....	....	....	....	67,878	108,086	2,102,588	1,781,223	22,486,460
Grand total......	15,624,976	30,874,973	11,882,919	2,303,384	129,832	2,648,674	1,893,365	773,022	70,903	108,086	2,102,588	11,977,614	80,390,336
Mill tally........	24,916,216	26,414,340	12,773,500	3,469,346	551,492	2,286,615	2,365,462	788,487	81,628	159,788	2,320,060	7,217,901	83,345,231

Lumber shipment by seventeen lumber companies, January 1 to December 31, 1920.

Destination.	Red Lauan and Tangile.	White Lauan.	Apitong.	Guijo.	Manga-chapuy.	Lumbayao.	Yacal.	Palosapis.	Miscellaneous.				Total.
									First group.	Second group.	Third group.	Fourth group.	
United States	3,942,736	1,922,384	187,826	...	...	559	...	...	...	...	...	15,094	6,068,599
Africa	11,087	13,601	...	...	...	...	...	...	...	...	...	...	24,688
Shanghai	876,564	425,466	130	...	...	...	...	...	...	...	...	4,108	1,306,268
Hongkong	...	212,227	...	...	...	...	...	...	11,293	...	...	...	223,520
Manila	11,513,150	18,654,788	12,509,460	1,657,812	120,169	1,221,501	1,488,887	646,415	683,020	11,584	430,494	3,999,217	52,836,497
Luzon Ports	157,049	279,329	454,964	47,851	1,249	...	4,186	56,360	14,716	1,977	1,006,722	161,286	2,185,689
Cebu	934,222	573,754	689,299	103,929	28,290	206,812	69,535	...	4,569	7,294	34,642	389,840	3,047,186
Iloilo	483,751	298,828	74,265	7,348	592	...	578	...	...	...	...	103,840	969,202
Visayan Ports	1,173,268	504,039	395,406	9,293	...	23,195	1,245	471	...	...	1,866,587	105,388	4,078,882
Zamboanga	125,503	493,081	274,284	89,197	19,560	438,333	54,567	...	9,096	51,736	54,763	200,678	1,810,798
Davao	50,998	95,000	814	1,641	...	1,815	30	...	136	...	...	115,146	265,580
Mindanao and Sulu Ports	650,131	665,801	502,845	108,558	37,187	180,374	41,109	14,735	5,978	4,754	947	255,766	2,468,185
Unclassified Ports	5,324,259	6,035,708	1,709,329	9,222	3,526	27,668	4,069	...	5,154	...	...	1,085	13,120,020
Grand total	25,242,718	30,174,006	16,798,622	2,034,851	210,573	2,100,257	1,664,206	717,981	733,962	77,345	3,394,155	5,251,438	88,400,104
Mill tally	26,441,950	27,701,090	19,786,494	3,057,913	359,756	1,978,647	1,888,712	1,169,201	899,385	539,633	3,147,852	2,967,975	89,938,608

FOREIGN MARKETS.

While local markets have been the principal buyers of the lumber so far produced in the Philippines and will undoubtedly continue to absorb large quantities, a continuation of the present development of the lumber industry and a development on the scale warranted by the resources of Philippine forests will depend very largely on the better development of export markets. Although shipping and general trade conditions brought about by the European War greatly interfered with foreign shipments of lumber during the past five or six years, it is believed that too little attention has been paid to the possibility of developing these markets and too much reliance has been placed on the local trade, so that local depressions in the lumber market have had an unwarranted reaction on the lumber companies. An illustration of this is contained in the recent financial stringency which has brought considerable depression in the lumber market. Almost simultaneously this office received several inquiries from foreign sources as to possibilities of securing large quantities of timber which were referred to local lumbermen.

However, little response has been received to these inquiries owing to the fact that the few companies which have done anything in the export line already had sufficient orders for their export trades and the remainder were unprepared to handle this business.

The substitution of Philippine lauans and tangile on the American market for the diminishing supply of true mahogany has been going on for some years past and deserves to be established, with proper advertising, on its own merits rather than as a substitute for a totally different species.

With reference to the China market, an article in a recent number of the *West Coast Lumberman* states:

> China imports annually from 2,000,000 to 4,000,000 cubic feet of hardwood, chiefly through the leading import centers of Shanghai and Tientsin.
>
> During the three months period from January to March, 1920, Shanghai imported 217,174 cubic feet of hardwood * * * Singapore, Japan, and South America, in the order named, dominated the trade.
>
> Tientsin is a growing center for trade in lumber. Tientsin's timber imports (hardwood) during 1919 were 837,959 cubic feet of rough, hewn and sawn material. From January 1 to April 17, 1920, Tientsin imported 37,050 superficial feet of rough hardwood * * * Hankow is also an important and growing center for lumber imports. More than 4,000,000 square feet of softwood, 78,000 cubic feet of hardwood, and 339,000 sleepers were imported in 1918 * * *

China's imports of timber come chiefly from the United States, Japan, Canada, Norway, Singapore, India, Indo-China, and the Dutch East Indies. During the war, Philippine lumber obtained a foothold in China's markets.

Philippine lumber has been known on the China market for a very long time. As a matter of historical interest, Chinese records a thousand years old speak of importations of timber from the Philippines. And with the constantly growing demand for lumber which the prospective and actual development of China indicates, the active participation of Philippine lumber in this market seems only dependent on the activity of local lumbermen in developing the trade.

The following tables show the total exports and imports of lumber and timber through Philippine ports during the past three years, by principal species and countries of origin and destination.

Lumber and timber exported from the Philippine Islands.

	1920			1919			1918		
	Cubic meter.	Board feet.	Value.	Cubic meter.	Board feet.	Value.	Cubic meter.	Board feet.	Value.
United States:									
Tangile timber							31	13,144	₱1,015
Narra lumber				?		₱50			
Tangile lumber	6,875	2,915,000	₱557,388	3,515	1,490,360	260,207	3,268	1,385,632	229,494
Almon lumber	1,892	802,208	111,877	459	194,616	18,504	1,056	447,744	35,450
Lauan lumber	10,014	4,245,936	446,879						
Miscellaneous lumber	43	18,232	3,077	4,836	2,050,464	251,840	2,656	1,126,144	117,679
Total	18,824	7,981,376	1,119,221	8,810	3,735,440	580,601	7,011	2,972,664	383,638
To Hongkong:									
Miscellaneous timber	48	20,352	1,000	252	106,848	5,912	168	71,232	10,815
Narra lumber							1	424	163
Almon lumber	88	37,312	2,436				2,693	1,141,832	42,787
Lauan lumber	501	212,424	19,169						
Miscellaneous lumber	416	176,384	37,324	1,278	541,872	52,572	1,165	493,960	37,279
Total	1,053	446,472	59,929	1,530	648,720	58,484	4,027	1,707,448	91,044
To China:									
Narra timber				3	1,272	360			
Miscellaneous timber	1	424	250	43	18,232	5,050			
Narra lumber							10	4,240	1,032
Tangile lumber	24	10,176	3,714	535	226,840	17,890	8	3,392	395
Almon lumber							10	4,240	998
Lauan lumber	5,900	2,501,600	247,608						
Miscellaneous lumber	2,361	1,001,064	103,698	4,111	1,743,064	147,189	5,457	2,313,768	163,809
Total	8,286	3,513,264	355,270	4,692	1,989,408	170,439	5,485	2,325,640	166,229
To Japan:									
Narra timber	1	424	150						
Miscellaneous timber	21	8,904	4,118	90	38,160	1,982			
Narra lumber	?		11			100			
Tangile lumber				5	2,120	500	7	2,968	1,130
Almon lumber				?			?		20
Miscellaneous lumber	15	6,360	5,582	7	2,968	1,146	4	1,696	753
Total	37	15,688	9,861	102	43,248	3,728	11	4,664	1,908

Lumber and timber exported from the Philippine Islands—Continued.

	1920			1919			1918		
	Cubic meter.	Board feet.	Value.	Cubic meter.	Board feet.	Value.	Cubic meter.	Board feet.	Value.
To Australia:									
Tangile lumber	117	49,608	₱10,301	22	9,328	₱1,677	4	1,696	₱174
Almon lumber	1,102	467,248	57,285	446	189,104	18,812	....	....	....
Lauan lumber	480	208,520	25,850	....	....	....	....	....	....
Miscellaneous	....	....	....	99	41,976	6,296	9	3,816	252
Total	1,699	720,376	93,436	567	240,408	26,785	13	5,512	426
To United Kingdom:									
Narra lumber	1	424	192	....	....	....	....	....	....
Tangile lumber	798	336,282	58,764	....	....	....	....	....	....
Lauan lumber	1,168	495,232	76,913	....	....	....	....	....	....
Miscellaneous lumber	459	194,616	34,777	....	....	....	....	....	....
Total	2,421	1,026,504	170,646	....	....	....	....	....	....
To Canada:									
Almon lumber	94	39,856	6,000	....	....	....	....	....	....
Lauan lumber	208	86,072	12,588	....	....	....	....	....	....
Miscellaneous lumber	....	....	....	362	153,488	14,964	....	....	....
Total	297	125,928	18,588	362	153,488	14,964	....	....	....
To British East Indies:									
Miscellaneous timber	7	2,968	720	2	848	800	....	....	....
Miscellaneous lumber	13	5,512	1,711	....	....	....	....	....	....
Total	20	8,480	2,431	2	848	800	....	....	....
To British Africa:									
Lauan lumber	46	19,504	8,000	....	....	....	....	....	....
To Dutch East Indies:									
Miscellaneous lumber	....	....	....	4	1,696	126	....	....	....
To Guam:									
Lauan lumber	10	4,240	1,000	....	....	....	....	....	....
Tangile lumber	....	....	....	....	....	....	9	3,816	680
Miscellaneous lumber	....	....	....	....	....	....	143	60,632	6,876
Total	10	4,240	1,000	....	....	....	152	64,448	7,556

To Spain:									
Narra lumber	1	424	550	....	....	....	....	....	....
Miscellaneous lumber	....	....	415	....	....	....	....	....	....
Total	1	424	965	....	....	....	....	....	....
To all countries:									
Narra timber	1	424	150	3	1,272	360	....	....	....
Tangile timber	....	....	....	....	....	....	31	13,144	1,015
Miscellaneous timber	77	32,648	6,088	387	164,088	13,244	168	71,232	10,815
Total timber	78	33,072	6,238	390	165,360	13,604	199	84,376	11,830
Narra lumber	2	848	753	....	....	150	11	4,664	1,195
Tangile lumber	7,809	3,311,016	630,167	4,077	1,728,648	280,274	3,296	1,397,504	231,873
Almon lumber	3,176	1,346,624	177,598	905	383,720	37,316	3,759	1,593,816	79,250
Lauan lumber	18,322	7,768,528	832,957	....	....	....	....	....	....
Miscellaneous lumber	3,307	1,402,168	186,584	10,697	4,535,528	474,083	9,434	4,000,016	326,648
Total lumber	32,616	13,829,184	1,828,059	15,679	6,647,896	791,823	16,500	6,996,000	638,966
Grand total	32,694	13,862,256	1,834,297	16,069	6,813,256	805,427	16,699	7,080,376	650,796

Lumber and timber imports into the Philippine Islands.

	1920			1919			1918		
	Cubic meter.	Board feet.	Value.	Cubic meter.	Board feet.	Value.	Cubic meter.	Board feet.	Value.
From United States:									
Cedar timber	....	....	....	389	164,936	₱5,924	....	....	....
Ties	....	....	....	....	....	....	1,305	....	₱659
Miscellaneous timber	121	51,304	₱2,149	36	15,264	2,670	96	40,704	4,900
Pine lumber	2,545	1,079,080	110,172	4,612	1,955,488	247,345	6,235	2,643,640	202,008
Redwood lumber	851	360,824	55,185	871	369,304	30,833	1,294	548,656	37,210
Cedar lumber	270	114,480	11,164	87	15,688	2,355	499	211,576	7,223
Cedar box shooks	....	....	....	....	....	....	....	....	64,383
Miscellaneous lumber	9,687	4,107,288	451,662	6,657	2,822,568	242,285	4,088	1,733,812	117,084
Total	13,474	5,712,976	630,332	12,602	5,343,248	531,412	12,212	5,177,888	432,808
From Canada:									
Miscellaneous timber	69	29,256	1,743	....	....	....	7	2,968	680
Pine lumber	358	151,792	10,409	....	....	....	....	....	....
Miscellaneous lumber	3,231	1,369,944	82,147	1,062	450,288	43,719	742	314,608	16,357
Total	3,658	1,550,992	94,299	1,062	450,288	43,719	749	317,576	17,037
From Hongkong:									
Miscellaneous timber	6	2,544	237	....	....	....	....	....	....
Cedar lumber	614	260,336	12,283	....	....	....	....	....	....
Total	620	262,880	12,520	....	....	....	....	....	....
From China:									
Miscellaneous timber	2	848	22	8	1,272	53	20	8,480	233
Miscellaneous lumber	142	60,208	4,044	29	12,296	510	50	21,200	724
Total	144	61,056	4,066	32	13,568	563	70	29,680	957
From Japan:									
Cedar timber	....	....	....	....	....	....	25	10,600	985
Cedar box shooks	....	....	....	....	....	....	....	....	3,889
Pine lumber	....	....	....	....	....	....	17	7,208	608
Miscellaneous lumber	....	....	4	30	12,720	212	20	8,480	150
Total	....	....	4	30	12,720	212	62	26,288	5,632

From British East Indies:									
Miscellaneous timber	111	47,064	1,516	44	18,656	1,339			
Miscellaneous lumber	435	184,440	16,063	343	145,432	13,923	150	63,600	4,307
Total	546	231,504	17,579	387	164,088	15,362	150	63,600	4,307
From British West Indies:									
Miscellaneous timber							1,664		2,147
From French East Indies:									
Miscellaneous timber				3	1,272	96			
Miscellaneous lumber	13	5,512	32	7	2,968	239	26	11,024	752
Total	13	5,512	32	10	4,240	335	26	11,024	752
From Guam:									
Miscellaneous lumber	2	848	200						
From Spain:									
Cedar box shooks									1,738
Miscellaneous lumber	31	13,144	1,302						
Total	31	13,144	1,302						1,738
From Netherlands:									
Cedar box shooks			1,596						
From Dutch East Indies:									
Cedar timber							50	21,200	1,137
From Germany:									
Miscellaneous timber							20	8,480	1,589
Pine lumber							2	848	15
Miscellaneous lumber				29	12,296	556			
Total				29	12,296	556	22	9,328	1,604
All countries:									
Cedar timber				389	164,936	5,924	75	31,800	2,122
Miscellaneous timber	309	131,016	5,667	86	36,464	4,158	1,807	766,168	9,549
Cedar lumber and box shooks	884	374,816	25,043	87	15,688	2,355	499	211,576	77,283
Pine lumber	2,903	1,230,872	120,581	4,612	1,955,488	247,345	6,254	2,751,696	202,631
Redwood lumber	851	360,824	55,185	871	369,804	30,833	1,294	548,656	37,210
Miscellaneous lumber	13,541	5,741,384	555,454	8,157	3,500,968	301,444	5,076	2,152,224	139,374
Total	18,488	7,838,912	761,930	14,152	6,000,448	592,059	15,005	6,862,120	468,119

DIVISION OF FOREST LANDS AND MAPS.

SECTION OF PUBLIC FOREST LANDS CASES.

The same difficulties encountered in former years have been observed in handling the cases pertaining to this section. Some of these difficulties may be obviated by establishing a more effective coöperation between this Bureau and the Bureau of Justice.

The following table shows the status of the claims received during 1920:

G. L. R. O.	Number received.	Action.	Opposition withdrawn after inspection.	Pending decision of court.	Number of hectares adjudicated to the Insular Government.	Remarks.
Cadastral	6	1	....	1	....	....
Ordinary	2,452	50	23	25	8.47	1 lost in court.
Total	2,458	51	23	26	8.47	....

One case was lost because the ranger who examined the land was in the field and could not be reached before the hearing was over. In the case which was won over eight hectares of mangrove swamp were declared public land.

SECTION OF PRIVATE FOREST LANDS REGISTRY.

Forty-one parcels of land with a total area of 47,723 hectares, 82 ares, and 90 centares have been registered in accordance with the provisions of section 1829 of the Administrative Code, and examined for the information of the Collector of Internal Revenue. The decrease of the number of parcels registered during this year as compared with that of last year is due to a great number of applications rejected for registration for lack of proper documents or because the boundaries are too indefinite to be located on the ground. The latter case, when conflicts and friction between licensees of the Bureau of Forestry and the claimants have taken place, involves questions of fact which are more or less difficult to decide.

In rejecting an application, if the land, because of the condition of its soil and slight value of its forest products, is more valuable for agricultural than for forest purposes, the claimant is advised to perfect his title in the court and is informed that in the mean time, the land is considered as an unregistered private woodland and that the utilization of forest products found thereon will be governed by section 1513 of the Administrative Code; if the land or portion of it is more valuable for forest than for agricultural purposes, the claimant is informed that the whole area or portion of it is considered as a part of the public forest until he has perfected his claim in the court and that the forest products found thereon will be disposed of by the Bureau in accordance with the forest laws and regulations. Also, he is warned not to cut or remove any forest products or clear any portion of the forested portion without first securing a proper license or permit from the Director of Forestry. But since the latter procedure has no legal force, to protect the rights and business of a licensee operating in an area considered by the Bureau of Forestry as part of the public forest, the legislation recommended last year, authorizing the Director of Forestry to settle the questions of fact, which settlement, once approved by the Department Secretary, shall be final so long as the Court of Land Registration, on request by the claimant, might not decide the question, is now again recommend for the good of the public in general and for the interest of efficient administration in particular.

The following table shows the private woodlands registered up to December 31, 1920:

Registered private woodlands.

Calendar year.	Number of—			
	Parcels.	Hectares.	Ares.	Centares.
1900	420	20,643	68	51
1901	201	68,386	06	95
1902	23	16,412	27	44
1903	3	1,305	94	65
1904	8	29,228	47	82
1905	12	6,631	63	89
1906	21	12,736	95	24
1907	17	28,338	73	05
1908	10	585	97	58
1909	14	6,215	86	62
1910	4	8,653	85	22
1911	5	5,533	67	26
1912	14	6,552	34	89
1913	26	15,229	58	36
1914	16	23,230	05	07
1915	27	13,304	36	95
1916	37	51,668	77	49
1917	48	7,985	68	39
1918	84	43,213	17	26
1919	110	14,948	71	39
1920	41	47,728	82	90
Total	1,141	428,474	66	88

SECTION OF PUBLIC LANDS APPLICATION.

The provisions of the new Land Law have caused a radical change in the procedure in vogue for classifying lands. Formerly it was customary to examine parcels of land applied for by individuals. This was done in connection with other work of rangers or when other equally important forest work permitted. The time of the field men was occupied with a multitude of small parcels. Now it has been necessary to detail a large body of specially trained men for the sole work of examining and classifying lands into forest zones and areas that may be alienated at the request of the Director of Lands. The importance of this work and its future potentialities necessitate that this classification of land must be made by men of training and experience. The result has been to strip forest stations of the most competent men, leaving in their place temporary forest guards who could at least patrol the forest and thus detect or prevent violations of the Forest Laws. The forest officers drawn from all districts, were organized into parties and they have examined, since last August, 182,982 hectares of public land which may be alienated, in the following provinces:

	Hectares.
Camarines Norte	9,000
Camarines Sur	33,809
Cotabato	1,024
Lanao	1,024
Leyte	17,124
Mindoro	45,579
Negros Occidental	40,320
Nueva Esija	12,580
Pangasinan	496
Sorsogon	18,640
Tayabas	1,024
Bataan	2,362
Total	182,982

In addition, the following individual applications for public lands were acted upon:

Summary of Table I, appendix.

Pending on December 31, 1919	4,823
Received during 1920	1,191
Total	6,014
Certified to the Bureau of Lands for agriculture	2,356
Certified to the Bureau of Lands for forestry	436
Returned to the Bureau of Lands without certification	380
Total	3,172
Pending on December 31, 1920	2,842

SECTIONS OF FOREST ZONES, RESERVES AND COMMUNAL FORESTS.

Salinas Forest Reserve.—The Salinas Forest Reservation was proclaimed by Executive Order No. 44 on May 18, 1914, for the purpose of protecting the famous salt spring of Salinas, Nueva Vizcaya.

The reserve is managed by the provincial governor, who supervises the manufacture of salt. The province has put in evaporating kettles which are leased to professional salt makers and to individuals who come there in large number for their annual salt supply.

Each person gets firewood wherever it is most convenient, and, as a result, the fuel around the salt works is disappearing rapidly. It is probable that the natural supply would be equal to the demand if it were not for the grass fires. The kogon hills are burned off once or twice a year and as a result no shrubs can survive.

A former attempt to plant firewood trees failed because of the fires, and all future attempts will also fail unless fires are prevented. The planting of firewood species, namely Ipil-ipil (*Leucaena glauca*) and Madre-cacao (*Gliricidia sepium*), will be of great benefit and this work must be undertaken soon, or else the cost of the production of salt will become excessive owing to the expense of fuel. The planting of these trees passed the experimental state years ago, and nothing will prevent the establishment of firewood areas at Salinas, except the lack of funds to do the work and to protect the plantation from fire for three or four years.

Makiling Forest Reserve.—This reserve was created on November 21, 1910 by Proclamation No. 106 of the Governor-General of that year with the double purpose of making silvicultural studies and experiments, and for the establishment of the Forest School. On November 30, 1920, the Makiling Forest Reserve was abolished by Proclamation No. 60 and made "The Makiling National Botanical Garden." The abolition of the Forest Reserve does not in any way effect the purpose for which it was created, for the Bureau of Forestry has a joint control of the management and beautification of the garden.

Communal Forests.—In accordance with the provision of the law, 69 parcels with a total area of 9,009 hectares have been located, studied and designated as communal forests.

The following tables show the total number of communal forests established up to December 31, 1920, and their distribution by provinces:

Commercial forests established from 1908 to 1920.

Year.	Parcels.	Hectares.
1908	19	5,326.00
1909	19	6,609.00
1910	19	5,796.00
1911	53	15,147.60
1912	59	10,957.00
1913	26	3,887.00
1914	45	6,860.00
1915	90	12,129.00
1916	110	15,862.00
1917	83	10,110.00
1918	61	7,704.82
1919	63	10,537.35
1920	69	9,008.85
Total	716	119,454.62

Statement of communal forests established up to December, 1920.

Provinces.	Parcels established.		Total parcels established up to 1920.	Municipalities, rancherias or townships.			Cancelled.	
	Before 1920.	During 1920.		With C. F.	Without C. F.	Area in hectares of parcels established up to 1920.	Parcels.	Hectares.
Abra	26	1	27	15	23	5,448.00	......	....
Albay-Catanduanes	12	4	16	11	13	1,819.00	......	....
Antique	4	......	4	4	10	984.00	......	....
Bataan	15	1	16	12	......	4,791.40	2	464.00
Batanes	......	......	......	......	6	....	......	....
Batangas	1	1	2	1	23	136.00	......	....
Bohol	31	2	33	22	14	3,792.80	......	....
Bulacan	2	......	2	2	22	340.16	1	232.16
Cagayan	34	3	37	20	4	4,439.60	1	66.00
Camarines Norte	8	......	8	7	2	1,171.00	......	....
Camarines Sur	32	2	34	24	7	4,006.50	......	....
Capiz	21	2	23	11	6	2,984.00	......	....
Cavite	......	......	......	......	20	....	......	....
Cebu	10	......	10	7	43	1,175.00	......	....
Ilocos Norte	20	2	22	15	15	7,269.00	4	1,127.00
Ilocos Sur	21	3	24	21	17	8,278.00	......	....
Iloilo	10	4	14	7	23	1,817.00	......	....
Isabela	18	1	19	13	13	3,181.00	1	106.00
Laguna	12	1	13	10	18	1,496.00	......	....
La Union	10	......	10	14	4	3,016.00	......	....
Leyte	35	7	42	20	26	4,914.68	......	....
Mindoro	2	2	4	3	13	884.00	......	....
Misamis	20	1	21	13	37	3,383.00	......	....
Mindanao-Sulu:								
Agusan	1	......	1	1	59	160.00	......	....
Bukidnon	1	......	1	1	12	620.00	......	....
Cotabato	......	......	......	......	30	....	......	....
Davao	2	......	2	1	14	164.00	......	....
Lanao	2	......	2	2	36	800.00	......	....
Sulu	......	......	......	......	27	....	......	....
Zamboanga	3	1	4	2	75	327.00	1	9.00
Mountain Province:								
Amburayan	6	......	6	5	4	1,754.00	......	....
Apayao	......	4	4	1	1	606.00	......	....
Benguet	1	......	1	1	13	100.00	......	....
Bontoc	......	......	......	......	2	....	......	....
Ifugao	......	......	......	......	1	....	......	....
Kalinga	......	......	......	......	1	....	......	....
Lepanto	2	......	2	1	10	1,225.00	......	....
Nueva Ecija	23	4	27	23	37	5,677.00	1	195.00
Nueva Vizcaya	2	3	5	4	15	664.00	......	....
Occidental Negros	32	......	32	14	11	3,633.00	1	240.00
Oriental Negros	16	......	16	13	84	1,596.00	......	....
Palawan	......	......	......	......	15	....	......	....
Pampanga	3	......	3	3	18	395.00	......	....
Pangasinan	38	4	42	28	36	11,563.48	......	....
Rizal	6	......	6	4	21	901.00	1	76.00
Romblon	6	......	6	4	4	485.00	......	....
Samar	47	4	51	31	14	8,088.00	......	....
Sorsogon-Masbate	18	3	21	14	12	2,079.00	......	....
Surigao	13	2	15	8	6	2,884.00	......	....
Tarlac	10	......	10	7	9	1,849.00	1	265.00
Tayabas	41	3	44	21	6	4,499.00	1	126.00
Marinduque	8	2	10	5	2	1,432.00	......	....
Zambales	15	2	17	12	1	3,227.00	......	....
Total	640	69	709	454	935	119,454.62	15	2,906.16

	Parcels.	Hectares.
Total number of parcels and hectares established from 1908 to 1920	709	119,454.62
Total number of parcels and hectares cancelled in various years	15	2,906.16
Balance in force	694	116,188.46

Forest Zones.—In connection with the work of examining and classifying lands that will be disposed of and alienated by the Director of Lands, forest zone lines have been located by placing corners between forest and agricultural lands. In most cases the corners do not form a close boundary and the reason for this is that the work is carried on only in those regions which the Director of Lands needs for immediate certification.

Forest zone lines have been located in the following municipalities:

Municipalities.	*Provinces.*
Labo	Camarines Norte.
Calabanga	Camarines Sur.
Tinambac	Camarines Sur.
Naga	Camarines Sur.
Bongabon	Nueva Ecija.
Calapan	Mindoro.
Bongabon	Do.
Capoocan	Leyte.
Irosin	Sorsogon.
Labrador	Pangasinan.
San Carlos	Negros Occidental.
Mariveles	Bataan.

MAPPING AND DRAFTING SECTION.

A map of the Visayas and Mindanao on a scale of 1:400,000 was prepared, which like a similar map for Luzon made in 1919, will include all of the latest forest and other data of value. A large amount of additional data has been added to the progress maps, which are drawn to a scale of 1:100,000 and 1:20,000.

Topographical and forest data taken in connection with the work of classifying agricultural and forest lands have been compiled to accompany the reports of the forest officers who were in charge of the work and also to accompany the certification of the Director of Forestry to the Director of Lands of the portion which may be disposed of and alienated by the latter. Also, the data taken in connection with the forest reconnaissances in the northern end and southern end of Palawan have been compiled to accompany the report of said reconnaissances. In addition, tracings were made from different plans for communal forests, maps of private lands for registration, models and various other drafting work. Four thousand and seventy-three (4,073) copies of blue prints were prepared for the public in general and for official uses.

Topographical and forest notes taken during 1920.

District No.	Received.	Pending.	Total.	Forest valuation.
	Kilometers.	*Kilometers.*	*Kilometers.*	*Hectares.*
District No. 1	335.49	421.38	756.87	20.50
District No. 2	52.13	197.03	249.16	4.70
District No. 3	6.01	24.46	30.47	2.84
District No. 4	519.90	229.76	749.66	52.85
District No. 5	352.72	343.32	696.04	54.00
District No. 6	722.49	375.20	1,097.69	201.63
District No. 7	273.02	671.37	944.39	105.50
District No. 8	261.18	117.22	378.40	40.02
District No. 9	458.19	200.58	658.77	295.10
District No. 10	306.85	608.96	915.81	126.27
District No. 11	256.96	114.27	370.23	216.16
District No. 12	455.50	108.46	563.96	49.45
District No. 13	467.91	149.60	617.51	11.00
Total	4,467.35	3,561.61	8,028.96	1,179.52

SECTION OF FOREST RECONNAISSANCE.

Palawan.—In order to secure information regarding merchantable forests and to investigate the possibilities for a more intensive untilization of the northern end and the southern end of Palawan Island, a forest reconnaissance party composed of one forest supervisor and three rangers was sent out.

Northern end of Palawan.—The region covered by the party has an area of about 44,562 hectares. It extends from the coast of Malampaya sound about one kilometer to five kilometers to the interior. The country in general is rough. The hills rise abruptly from the coast and form several broken chains ranging from 200 to 500 meters in height. The rivers that drain the area are short and small, but some are navigable by bancas for a few kilometers toward the interior.

The soil cover is divided as follows:

	Hectares.
Commercial forest	23,240
Non-commercial forest and brush	17,185
Cultivated land	819
Grass and open land	313
Mangrove swamps	3,005
Total	44,562

For the purpose of administration, the whole area is divided into ten compartments and the detailed report of each compartment is filed in the records of the Division of Forest Lands and Maps. The average stand of the forest of each compartment varies from 42 cubic meters to 175 cubic meters per hectare. The principal merchantable species, are: Apitong (*Dipterocarpus* spp.), ipil (*Intsia bijuga*), amugis (*Koordersiodendron pinnatum*), akle (*Albizzia acle*), bitanhol (*Calophylum* spp.), makaasim (*Eugenia* spp.) *malugai* (*Pometia pinnata*), banaba

(*Lagerstroemia speciosa*), nato (*Palaquium* spp.), malasantol (*Sandoricum vidalii*), and sakat (*Terminalis nitens*).

The most suitable areas for sawmill sites are at Banbanan and Baluran Bays and each has enough timber in the vicinity to supply a mill having a daily capacity of 10,000 board feet. But due to the mountainous character of the country, the logging units will be small and in some cases portable mills might be used to advantage. Whenever the land is level and therefore suited for agriculture, clear cutting would be required and elsewhere a certain proportion of the trees should be left to restock the forest. In addition to the area which should be opened for agricultural purposes after the timber has been utilized, about 4,500 hectares, located mostly along the rivers, can be classified as agricultural lands. The mangrove swamps are not suited for exploitation on a large scale and should be kept for local use.

Southern end of Palawan (including adjacent islands).—The region covered by the party has an area of about 49,396 hectares divided as follows:

	Hectares.
Commercial forest	29,778.30
Non-commercial forest	12,189.90
Temporary clearings (kaiñgins)	1,251.20
Open or grass land	1,656.00
Mangrove swamps	4,415.00
Total	49,396.60

The area is further divided into five compartments. The first compartment comprises the southern end of Palawan and the other four compartments comprise the adjacent islands. The average stand of the forest of each compartment varies from 40 to 100 cubic meters per hectare and the important commercial species found are amugis (*Koordersiodendron pinnatum*), malugai (*Pometia pinnata*), ipil (*Intsia bijuga*), bogo (*Garuga littoralis*), maranggo (*Azadirachta integrifoliola*), nato (*Palaquium* spp.), sakat (*Terminalia nitens*), akle (*albizzia acle*), kalantas (*Toona calantos*), and makaasim (*Eugenia* spp.).

No suitable sawmill sites were found because of a number of conditions. The sites near the forest either had no harbors or else had no fresh water, and protected anchorages were either far from a forest or else were on private land. Some of these difficulties could be easily overcome, but owing to the broken nature of the country only a small mill could be operated in in this region. In all probability this country will be logged by small licensees who will take advantage of favorable weather to raft their logs to sheltered anchorages and then sell them to mills in Manila or Iloilo.

Under the direction of several members of the faculty of the Forest School at Los Baños, the graduating class of 1921 carried on two forest reconnaissances which, while they were made for educational purposes, also resulted in the acquisition of valuable information for better forest management.

These consist of the forest reconnaissance of the Mount Lobo region in the Province of Batangas, and the mangrove swamp territory in the southern and southwestern part of Tayabas, in the municipalities of Pagbilao, Laguimanoc, Unisan, Pitogo, and Macalelon.

Mount Lobo Region, Batangas.—From Batangas Bay to Locoloco Point there are two mountains separated by a wide valley at the town of Lobo.

The first mountain on the shores of Batangas Bay was not examined because from all sides it was seen to be covered with grass, with only a few wooded gullies. The hills near Lobo were covered with brush, but this area was occupied by settlers who cleared off and abandoned successive parcels of land. Apparently by good fortune, rather than by design, these parcels came up to brush and not to grass as elsewhere on this mountain. Lone trees with long clear trunks are the sole remaining evidence that the entire mountain was once forested from top to bottom.

Conditions on Mount Lobo were different. There, the diversified geological formations have given rise it differences in topography and in vegetation. Furthermore, the remoteness of this region from all markets and centers of population has had its effect upon the occupations of the people and upon the forests.

From the Malabrigo Light House to Balibago Creek the formation is recently uplifted coral about fifteen meters above the sea. From here the ground rises gently to the higher ridges, which are of older limestone formation broken occasionally by volcanic dikes. There are precipitous crags, narrow canyons, and long cliffs in this region.

Along the coast, the land has been cleared and abandoned. The last general clearing took place in 1912, after which the settlers migrated to Mindoro to escape from the exactions of persons who claimed to own the land. The abandoned land is now covered with thorny shrubs and a few saplings of molave and other trees.

On the older limestone formation, molave occurs in a greater quantity, but because of the cliffs and because the best trees have been removed, not enough remain to warrant logging operations. In the dry season, this forest as well as that on the lower slopes is characterized by its leafless condition and the general drought resistant character of the vegetation. This is in striking contrast to the forest upon the dikes of igneous rock, which are evergreen, and contain many species of commercial importance. However, these dikes are narrow and far apart and the forest therefore is more interesting than valuable. Balibago Creek marks the dividing line between the limestone and igneous formations. From this creek to Locoloco Point the spurs from the main ridge come to the beach. The lower slopes are covered with brush and small trees, many being of commercial species. The thorny shrubs are not so abundant as on the limestone and there is a greater number of species. Clearings on steep slopes have destroyed the last of the timber that might have been logged.

Commercial forests are restricted to steep, inaccessible slopes and they are too small in area and too difficult to reach to warrant any lumbering operations.

The chief occupation of the people is raising cattle, which pick up a living in the brush lands. Feed is scarce in the dry season and while the stock is not starving yet the cattle eagerly browse on aroma (*Acacia farnesiana*), eating the tips of twigs down to the first hard thorns.

Far back, in the secluded spots, old clearings were discovered which, from the absence of bamboo and fruit trees, were evidently not made by farmers. Upon inquiry, it developed that armed parties used to take refuge in Mount Lobo after every insurrection. The oldest kaiñgins were being occupied by dipterocarps, whereas in the more recent clearings the brush land species predominated and only an occasional forest tree was found and then only at the base of the slopes which were forested.

To the north of Mount Lobo is a rolling country which is suited for stock raising. The number of stock could be greatly increased if the bits of agricultural land along streams were planted to alfalfa. However, to do this requires irrigation and irrigation is dependent upon the character of the forest cover. Nearly all the creeks are dry at their mouths and often for a kilometer or two inland. Even the largest creek, the Agas, threatens to dry up. The settlers on these streams assert that twenty or thirty years ago water was abundant, but when the forests were destroyed by kaiñgin makers, the springs and streams dried up. It is interesting to note that the people recognize the cause of the present lack of water. Fortunately, the absence of kogon in most of the Lobo range makes the reforestation of the region easy. It is doubtful whether the present forest cover will be worth anything, as but few trees of duñgon and molave are left to produce seed. However, when the time comes to plant valuable trees, the present species will shelter the newly planted trees.

The bare mountain near Batangas is a more difficult problem, because before anything can be done, it is necessary to prevent or control grass fires, and then plant suitable forest trees. That this can be done has been demonstrated at Talisay, Cebu.

The main feature of this reconnaissance was the compilation of a topographic map showing all trails and vegetation.

About 22 hectares of valuation survey were taken, showing an average stand of 110 cubic meters per hectare in the commercial forest. The principal species found in their order of abundance are bagtikan (*Parashorea malaanonan*), makaasim (*Eugenia* spp.), molave (*Vitex parviflora*), duñgon (*Tarrieta sylvatica*), oak (*Quercus* spp.), taluto (*Pterocymbium tinctorium*) dungau (*Astronia* spp.) katmon (*Dillenia* spp.), nato (*Palaquium* spp.), and white lauan (*Pentacme contorta*).

Forest protection is an essential in order to conserve the water supply of the farming region north of Mount Lobo. This protection should include the prevention of kaiñgins and the establishment of a forest reserve to prevent encroachment upon the remaining timber supply.

MANGROVE SWAMP TERRITORY, TAYABAS.

Object.—The object of this reconnaisance work in the swamps of the southwestern coast of Tayabas Province was to study its potentialities in forest resources, so that a convenient system of forest management can be applied in the exploitation of the mangrove swamps of this region with the end in view of conserving said forests for the continuous source of supply of forest products, and at the same time allowing substantial profit both to the investor and to the public.

Ownership.—With the exception of some swamps that are legally possessed by private owners in the locality, practically all the mangles in this region are public swamps. In spite of the strong opposition of the Bureau, with its convincing evidences that said mangroves are of public domain, for one reason or other, certain tracts passed into the hands of land grabbers.

There are still swamps which are claimed by various persons who have no evidences of ownership other than three or four trunks of naturally growing nipas in places adjoining their cultivated lands.

However, roughly estimating, the whole area of swamps that may be claimed, including those that were not specifically noted during the trip, would not come to over 260 hectares or 7 per cent of the total area of the mangles reconnoitered. In order that it may be determined how much of this estimated area can be considered legally possessed by private individuals and remain their recognized property, and show how much of it will go back to the direct control of the Bureau for the better management and conservation of its forest resources, all claimants were advised to have the titles of their lands registered in the Bureau of Forestry in accordance with Section 1829 of the Administrative Code.

It is evident that unless the Bureau adopts definite measures to prevent land grabbers from planting cocos or nipas in the public swamps, and from including portions of same in the survey of their cultivated lands with a view of registering their titles of their lands, the greater part of the valuable public swamps which need to be supervised by the Government for the prepetuation of the firewood crops growing thereon and for other forestry purposes, will pass into private hands.

Surrounding People and their Industries.—The municipalities of Pagbilao, Laguimanoc, Unisan, Pitogo, and Macalelon, Province of Tayabas, under whose jurisdictions the mangroves dealt with in this report come, are located along the coast. The inhabitants are Tagalogs. Some strangers from the neighboring provinces and Chinese who are engaged in commerce are also found.

The chief industry of the people is lumbering and the cultivation of coconuts from which copra is obtained. The first consists of extracting posts, square logs, sawn boards, and railroad ties. Some are engaged in boat building, in collecting firewood and tanbark, and in making charcoal. The last is at present in the hands of some Japanese at Laguimanoc and it is becoming an important industry in this region.

In charcoal-making, the kiln method is used by Japanese, which is simple in operation and produces excellent charcoal.

The Construction and Use of the Kiln.—A pear-shaped hole of 3.80 meters in length and 3.20 meters in width toward the rear part and about 80 centimeters at the front, is excavated in a well drained hillside to a depth of 80 centimeters. Having finished the hole, a mixture of either one-half burnt clay and one-half fresh soil or two-thirds clay and one-third ashes dampened with sea-water, forming a thick clay, is plastered along the side of the hole, making a wall about 20 centimeters thick, leaving the front face open. A chimney about 15 centimeters in diameter is dug at the back, having its lower opening at the level of the floor of the kiln and its outlet 30 centimeters distant from the rear wall. See figures 1 and 2.

The next step is to fill the space of the unfinished kiln with compact billets. Two layers of wood 1 meter in length are piled on end. The first stratum, serving as the base, needs be larger than the second over it. The remaining space is filled with short billets and twigs till an oblong dome-shape is attained, dry grass being used as a coating to smooth out all depressions. The pile of wood has a height toward the rear of 2 meters and in front of 1.40 meters. The mixture of clay is then moulded over this mound to a depth of 20 centimeters and is well beaten to make it compact. Three small holes, each about 7 centimeters in diameter, are made at the base of the dome about 20 centimeters above the ground surface, forming a symmetrical triangle. One hole is at the rear and the others are 1½ meters distant from it. See figure 3.

The structure is protected by a roof and is left to dry for two or three days when cracks begin to appear all over the surface. These cracks must be carefully patched with the mixture of clay. Then a smudge or low fire is built at the door, the billets therein having been temporally removed, to aid the discovery of crevices and to season the oven. The smoke penetrates thru all the spaces of the tiers and through the cracks if there are any. The smudge is kept burning for about 8 days by which time no more cracks appear and the kiln is dry.

The low fire at the entrance of the kiln is then removed, and the billets are returned to complete the tiers inside and in addition thereto kindling is added. The lower half of the door is closed with the same material as the kiln, mixed with stones to make it firmer and stronger, leaving a small aperture of 6 by 12 centimeters at the bottom of the door for the admittance of a little air during the burning of the wood. See figure 4.

With all drafts open, the fire is started at the upper half of the door. The fire works its way inward and downward over the top of the wood within. As soon as the fire reaches the rear part of the pile, which can easily be noticed through the holes, the door is walled up with the exception of the small hole below, and also either hole on the side of the kiln is entirely closed. One hour after, the vent on the opposite side is closed and 3 hours later the rear hole follows, leaving open only the small vent at the bottom of the door and the chimney, by which further burning is regulated. The kiln requires frequent attention. The boss or his assistant must observe closely that the fire within is not put out or the charcoal is not over burned. An amateur charcoal maker needs but a little practice and close observation at the beginning in order that he can make as good charcoal as an expert. See figures 5 and 6.

Firewood inside will continue to burn for about four days. During this time the smoke escaping at the chimney is dark in color. When the process of combustion inside the kiln is completed, the smoke rising from the chimney begins to be lighter in color and transparent, and can only be noticed as a whitish vapor when about one meter above the hole, thus indicating that all the wood inside has turned to glowing embers. This is the sign that all holes must be closed to entirely exclude the air and to put out the embers. It takes about three days for the embers to cool. The sign that there is no more fire inside the kiln is the cessation of the wave-like refraction of the heated air about the surface of the kiln. When no more heat waves are seen the door is opened for further cooling of the charcoal inside the kiln, which may require two or three hours, depending upon the temperature of the day. The charcoal is then taken out and the oven is filled with new billets as already described.

The kiln will remain in use for several years, if the clay is properly prepared and applied.

Three cords of firewood is the regular capacity of the kiln above described and 28 to 30 big sacks or about 5 cubic meters of charcoal can be obtained. This slight variation of the amount of charcoal obtained depends on the loose or close piling of the billets and upon under or over burning of the charcoal.

Ten and eighty-three hundredths cubic meters or 3 cords of loosely piled wood contain seven and six tenths cubic meters of solid wood and yield 5 cubic meters of charcoal, the approximate loss being 1.5 cubic meters. For further information in this connection see labor.

Fishing must not be overlooked as it is one of the important industries in the region, especially in Pagbilao and Laguimanoc.

The people engaged in this business are mostly from Cavite Province. Fish-corals are generally used in trapping fish in Tayabas Bay. A big quantity of fish is caught and exported every day and people who are engaged in this enterprise are making good money. Some people who see the great importance of this industry are establishing fishponds in the swamps wherein to rear the fry of a certain species, which they know will, upon arrival at a certain age, give them a tenfold profit when sold in the market.

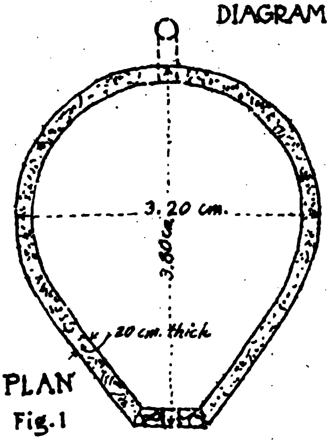
Fishing in the Swamps.—Some of the poor, especially those who live in the neighborhood of the mangroves, close the mouths of the creeks and rivers with a bamboo screen during high tide in order to entrap the fish at low tide, while some who do not have a screen just wander through the swamps and pick up such clams, teredoes, barnacles, and crabs as they may find. The fish that are abundant in the swamps are white perch, mullet, gobies, anchovies, shirmps, slip mouths, basking shad, and many others.

Among other profitable uses of the swamps not developed in this region are salt-making, extraction of tuba from nipa for vinegar or wine, making of shingles from nipa leaves, and extraction of corkwood (daluru).

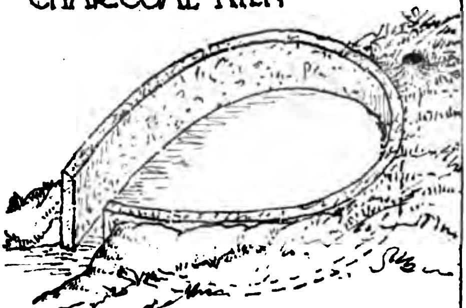
Locations and Area Covered.—These swamps are located along the southern and southwestern coast of Tayabas Province, from Verde Point 2.7 kilometers, south of Pagbilao to Osly River, including the swamps in Pulo Grande Island under the jurisdiction of the municipality of Pagbilao; thence from Osly to Kinagonan River, under the jurisdiction of the municipality of Laguimanoc; thence from Kinagonan to Cabulihan River, under the jurisdiction of the municipality of Unisan; thence from Cabulihan to Suliao River, under the jurisdiction of the municipality of Pitogo; and thence from Suliao to Cabuluan River, under the jurisdiction of the municipality of Macalelon. The areas in the different municipalities are approximately as follows:

	Hectares.
Area of swamps in Pagbilao, including Pulo Grande Island	1,100
Area of swamps in Laguimanoc	769
Area of swamps in Unisan	454
Area of swamps in Pitogo	644
Area of swamps in Macalelon	662
Approximate grand total	3,629

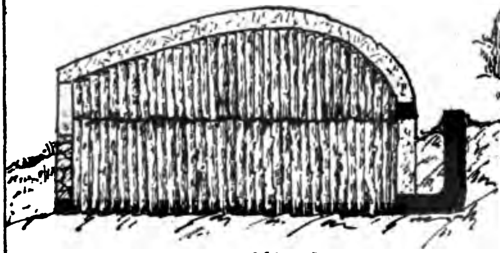
DIAGRAM SHOWING THE CONSTRUCTION OF CHAR-COAL-KILN



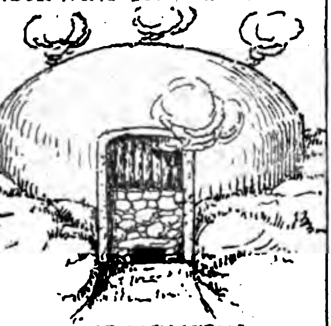
PLAN
Fig. 1



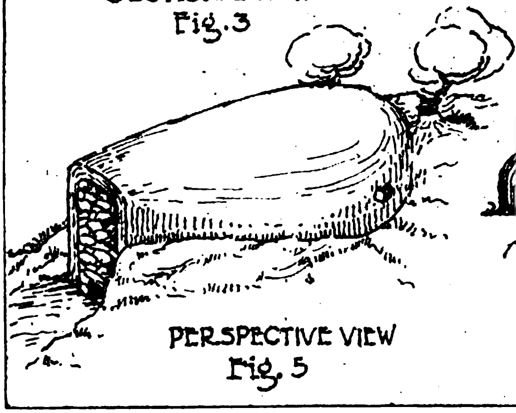
EXCAVATION SHOWING-PLASTERED-CLAY
Fig. 2



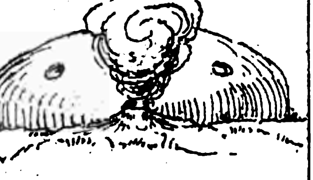
SECTIONAL VIEW
Fig. 3



FRONT VIEW
Fig. 4



PERSPECTIVE VIEW
Fig. 5



BACK-VIEW
Fig. 6

These mangrove swamps do not form a continuous strip along the seacoast, but are interrupted by elevated lands which are either covered with kogon or are planted with cocos. However, extensive swamps of about 1,000 hectares are found between Maruhi and Hinguiuin Rivers, in the jurisdiction of the municipalities of Pagbilao and Laguimanoc; the swamps toward the east and southeast of this vary in area from 10 to 300 hectares, situated mostly along the basins of the rivers draining the region.

Degree of Exploitation.—Prior to the year 1916, there was but little firewood business on the southwestern coast of Tayabas, due perhaps to the scarcity of coastwise transportation. But just as soon as the railroad line extended thru this region, giving a means of daily transportation between Manila and Hondagua, speculators from the neighboring provinces and from Manila commenced to compete with old licensees by applying for unoccupied cutting areas. Later on a strong rivalry between them was aroused. Each one was trying to watch the irregularities committed by other and when enough data was collected, the interested party would either take up the matter direct with the officer in charge or forward the case to the Bureau asking for an immediate investigation and transfer to himself of the area occupied by his victim. If it so happened that the report made by the forest officer was contrary to the desires of the interested party, or he thought that he had a very strong rival for some area, he would rush to some one with a "pull" who he thought would back him up. Because of this, forest officers are having a hard time in carrying on their work successfully. Some of the licensees who started with their own capital made the best utilization of the forest, and naturally gained much money in the business, while others who started with very little capital or with borrowed capital became very poor and even lost their cutting areas.

After the opening of the daily transportation facilities in this region, continuous shipment of large quantities of firewood from Tayabas have been made and are still going on. The municipalities favored by this are Pagbilao, Laguimanoc, and Unisan. Pitogo and Macalelon are still shipping their firewood to Manila and other markets by sea.

The following table shows the number of licensees and the amount and kind of forest products exported by them from each municipality from January to November, 1920:

Name of municipalities.	Kind of forest products.						
	Number of active licensees.	Tanbark.	Firewood.		Charcoal.	Total cubic meters.	Per cent of firewood.
		Tangal in kilos.	Langarai in cubic meters.	Tangal and bakauan in cubic meters.	Tangal and bakauan in cubic meters.		
Pagbilao	13	....	4,204	5,636	....	9,840	49
Laguimanoc	8	....	3,887	877	290	5,054	25
Unisan	4	....	1,048	429	....	1,477	7
Pitogo	2	....	17	....	....	17	1
Macalelon	4	2,511	....	3,612	....	3,612	18
Total	31	2,511	9,156	10,554	290	20,000	100

Some of the poor people are gathering firewood in insignificant amounts, say from 4 to 8 bundles each, from these swamps and they dispose of it for local consumption. This firewood is not listed in the records of the municipal treasurer, as no forest charges are paid on the same. Licensees are also selling firewood to the local bakeries and restaurants, but to a very limited extent, which will not come to 2 per cent of the total amount exported.

Uses of the Different Species.—The species cut extensively for firewood are bakauan (*Rhizophora* spp.), tangal (*Ceriops tagal*), langarai (*Bruguiera* spp.) and small quantities of other species. The first two species are also cut for charcoal. Tangal and bakauan are the two species preferred by the licensees because of the high quality of firewood and charcoal secured from them and because of the better prices which are realized from them. The bark of tangal, and rarely bakauan and pototan, is collected for tanbark. The bark of tangal is used locally for coloring tuba and for dying fish nets. The following list shows the various uses in this region of the different species found within the limit of these swamps, especially in regions where the high land forest is from 5 to 10 kilometers distant from the town.

Posts, tools handles; and railroad ties.—Tabau (*Lumnitzera littorea*), Dungon-late (*Heritiera littoralis*), and tabiging-itim.

Boards.—Pagatpat (*Sonneratia caseolaris*) and rarely Pototan.

House frame work.—Pototan, tangal, bakauan, langarai, tabau, and pagatpat.

Piling.—Dungon-late, tawalis (*Osbornia octodonta*), and pagatpat.

Over-cut areas.—As a result of the studies made it is estimated that almost 46 per cent of the total area of the swamps, or 1,692 hectares, are heavily over-cut for firewood, thus depriving these areas of their merchantable species. This over-cutting is distributed under each municipality as follows:

Names of municipalities.	Over-cut area in hectares.	Per cent of total over-cut by municipality.
		Per cent.
Pagbilao	732	41
Laguimanoc	384	23
Unisan	194	10
Pitogo	161	13
Macalelon	221	13
Total over-cut areas	1,692	100

From the above-table it can be seen that Pagbilao represents the biggest percentage of heavily over-cut areas, and some of them, especially those that are located south and east of the town and south of barrio Malicboy, have very few desirable species left and need a rest. Laguimanoc ranks next in its over-cut areas and will soon reach the same condition as Pagbilao. Unisan, like the preceding towns, does not think of the perpetuation of its forest resources altho its over-cut area is almost ½ of its total area of swamps. It will soon feel the shortage of firewood. Pitogo and Macalelon have a smaller percentage of over-cut areas at present, but they are very likely to follow the examples of their neighbors.

The above-mentioned over-cut areas are conspicuous on all the banks of the streams and in the case of the swamps of Pagbilao extend even over the entire swamp. One can easily see them from the railroad.

Labor.—There is a great scarcity of labor in this region and one can hardly hire a laborer for less than ₱1.50 a day. The great majority of the laborers engaged in the extraction of firewood and tanbark are imported from the Island of Marinduque and few, if any, are brought from other provinces. Some Japanese workers are also found, but they are mostly employed in charcoal-making and in lumbering.

Split firewood in this region is classified into three grades. The first grade is about 64 centimeters in length and 3 to 4 centimeters in thickness. It is split from the larger pieces. The second grade is about 62 centimeters in length and 2 to 3 centimeters in thickness. It is split from pieces of smaller diameter. The third grade is about 60 centimeters in length and 1 to 2 centimeters in thickness. It is split from the smallest diameter. Rajas are about one meter in length and from 5 to 6 centimeters in thickness and are split from trees of 10 to 20 centimeters in diameter. The cutting of the poles into lengths is done with hand saws and the splitting is done with short bladed, narrow axes, commonly known as belt axes.

The licensees carry on their operations in their cutting areas by means of contracts. In many cases, the laborers secure money in advance from the licensees. They are paid on the basis of the number of bundles of all grades of rajitas of 50 pieces a bundle, and by the number of pieces of rajas that they can deliver at any landing within the cutting area which is accessible to light bancas. The licensees pay all additional expenses in getting the firewood to market, including transportation from place of piling to either the railroad station or the anchorage of the freight boats, and also the cost of loading. The bancas used are furnished by the licensees.

In different municipalities and in swamps distant from the railroad stations, or the landing of the boats, the cost of cutting and transportation varies thus: operations near the railroad stations are from ₱3 to ₱5 more than those cutting and splitting in the distant swamps, but the cost of transportation of the firewood from place of piling in the cutting areas to the railroad stations is just the reverse. The licensees even offer to the same transporters a higher rate of pay in loading the railroad car.

The laborers employed in the operations in swamps near the railroad stations are those who have, if any, but very small amount of debts to the licensees; while the laborers employed in the work in the distant swamps are those who have taken big amounts of advance payment. Here lies the reason why the laborers cannot ask for a higher rate of pay or break loose from the licensees and find a job with better pay. This is also the reason why the licensees can do just what they please with the poor and ignorant laborers.

The following tables show the different costs of operations in the different municipalities based on 100 bundles of rajitas or 1,000 pieces of rajas, although the licensees generally sell their firewood to the purchasers by the carload, the price depending upon the number of bundles of firewood or rajas that the car may contain.

Cost of operations of making firewood (rajitas) for all species and grades in the swamps near the railroad stations of Pagbilao and Laguimanoc.

Cutting, splitting, and tying 100 bundles	₱11.00
Transportation to the railroad station	3.00
Loading into the railroad car	1.00
Forest charges (bakauan and tangal, 3.56 cu. m.)	.71
Total cost of operation	15.81

Cost of operations in places distant from railroad stations, Pagbilao and Laguimanoc.

Cutting, splitting, and tying 100 bundles	₱8.00
Transportation to the railroad station, 100 bundles	6.00
Loading into the railroad car, 100 bundles	1.50
Forest charges (bakauan and tangal of 3.56 cu. m.)	.71
Total cost of operation	16.21
Average total cost of operation	15.96

Selling price in the locality delivered on railroad cars.

100 bundles first grade rajitas	₱29.00
100 bundles second grade rajitas	24.00
100 bundles third grade rajitas	20.00

From the above table it can be seen that the extraction of rajitas in these two municipalities is the same for all grades of all species, but the local selling price for the three grades varies. The average cost of operations to the licensees per 100 bundles of firewood delivered at the railroad cars is ₱15.96 The licensees do not consider other expenses such as supervision of the work in the swamps, and the conducting of the business, and the depreciation of bancas. The licensees, therefore, make a net gain on first grade rajitas of ₱13.04, on the second grade of ₱8.04, and on the third grade of ₱4.04 per 100 bundles.

Cost of making rajas out of tangal and rarely langarai, in the swamps of Laguimanoc and Pagbilao near the railroad stations.

Cutting and splitting 1,000 pieces or rajas	₱15.00
Transportation to the railroad station, 1,000 pieces	9.00
Loading on railroad car, 1,000 pieces	1.20
Forest chrages on 1,000 pieces or (5.73 cu. m.) tangal and bakauan	1.15
Total cost of operations	26.35

Cost of operations distant from railroad stations, Pagbilao and Laguimanoc.

Cutting and splitting 1,000 pieces of rajas	₱10.00
Transportation to railroad station, 1,000 pieces of rajas	12.00
Loading on railroad car, 1,000 pieces of rajas	2.00
Forest charges on 1,000 pieces or (5.73 cu. m.)	1.15
The selling price in the locality of 1,000 pieces of rajas (tangal and bakauan) delivered on railroad car is	40.00
Average total cost of operations, 1,000 pieces	25.75
Profit per 1,000 pieces of rajas	14.25

If the stuff is mostly langarai, deduct ₱5 from the local selling price.

The licensees realize a larger profit on their business when they ship their firewood directly to Manila and sell it there than if they sell it to local dealers. But many of the licensees who have a meager capital, if they have any, could not do this because they always need ready cash to run the business and can not afford to wait for uncertain times of payment by their customers.

The following table will give one a fair idea of the additional gain when the firewood is sold at the Manila market, based on 100 bundles of rajitas or 1,000 pieces of rajas:

Average cost of operations of rajitas and their transportation from Pagbilao and Laguimanoc to Manila.

Cutting, splitting, and bundling 100 bundles	₱9.50
Transportation to the railroad station, 100 bundles	4.75
Loading into railroad cars, 100 bundles	1.25
Forest charges (bakauan or tangal, 3.56 cu. m.)	.71
Freight charge to Manila on railroad car	7.72
Total cost to the licensees	23.93

Selling price in Manila delivered at the railroad station.

100 bundles first grade rajitas	₱40.00
100 bundles second grade rajitas	36.00
100 bundles third grade rajitas	32.00

If a lot is all langarai, deduct ₱2 from each of the above selling prices.

From the above figures, it can be seen that the licensees make a gain of ₱16.07 per 100 bundles on first grade rajitas, ₱12.07 per 100 bundles on second grade and ₱8.07 per 100 bundles on third grade, when their firewood is sold in the Manila market, delivered at the railroad station at Paco or Tutuban. The total cost of operation and transportation to Manila is ₱23.93 per 100 bundles. The additional gains of the licensees when their firewood is sold in Manila are as follows:

Manila selling price per 100 bundles.		Local selling price per 100 bundles.	Additional.
On first grade rajitas	₱16.07	₱13.04	₱3.03
On second grade rajitas	12.07	8.04	4.03
On third grade rajitas	8.07	4.04	4 03
Total gain on 300 bundles on 8 different grades			11 09

Average total cost of operations in Laguimanoc, 1,000 pieces	₱25.75
Transportation to Manila based on 5.73 cubic meters	12.89
Total cost of operation and transportation	38.64
Selling price in Manila	60.00
Total cost of operation and transportation	38.64
Net gain in Manila	21.36
Net gain in locality	14.25
Additional gain when sold in Manila	7.11

If the stuff is mostly langarai, the selling price will be ₱50. Licensees in this locality do not deal much in rajas, as they said they could get more money from rajitas inasmuch as the latter are easier to handle than the former.

The following information as given by the licensees will enable one to find out how much gain a licensee can make for every carload of firewood of different grades:

One N. B. B. Car loads 1,000 bundles of first grade rajitas.
One N. B. B. Car loads 1,000 bundles of second grade rajitas.
One N. B. B. Car loads 1,300 bundles of third grade rajitas.
Freight charge from Laguimanoc to Manila, ₱80 to ₱90.
Approximate contents of one carload, 40 cubic meters.
One car of N. B. B. size will contain 7,000 pieces of rajas.

The cost of operations of firewood in the southwestern coast, including Unisan, Pitogo, and Macalelon is cheaper than that in the southern coast of Tayabas. Laborers are paid ₱6 per 100 bundles of rajitas and ₱10 per 1,000 pieces of rajas delivered at any designated landings by licensees. Unisan sends its firewood either to Panahon or directly to Manila; or else the firewood is sold at the landings to any boat calling at the place for ₱10 per 100 bundles on rajitas and ₱17.50 per 1,000 pieces of rajas. If their firewood is ever sold in Manila it is shipped under contract, that is, one-half of the firewood loaded on board is given to the owner of the boat as freight charges. In the latter case the licensees incur additional ₱2 expense for the transportation and loading on board for every 100 bundles of rajitas or 1,000 pieces of rajas. For the selling price in Manila, see preceding tables. The above information refers only to bakauan and tangal.

The firewood cut in these three towns is generally second grade rajitas, so that no different costs of operations on the other grades have been discussed under this paragraph.

Tanbarks.—The collection of tanbark in these swamps is very limited and only one licensee in Macalelon has been found extracting a little of this forest product. The following information may not be very reliable, as this was taken from one licensee only and from his first trial shipment of the bark; it is here given simply to convey an idea how the transaction of the business is done in this locality, based on one shipment of tanbark. The laborers are paid 20 centavos per bundle of tanbark one meter in length and 65 centimeters in diameter, weighing nine kilos if dry. An additional expense of 2 centavos is incurred in the transportation of every bundle from the landing to the boat. The freight charge is one-half of the quantity of the product loaded. The selling price in Manila is from 40 to 50 centavos per bundle minus the corresponding forest charges, which is 10% of the selling price, or 4 to 5 centavos, leaving to the licensee the amount of 35 to 45 centavos or an average of 40 centavos. From this it can be seen that if the product is sold at 40 centavos per bundle, the licensee will lose 8 centavos and, if sold at ₱0.50 he will gain only one centavo per bundle, which is a very poor business.

Charcoal-making.—Like the operations of the other forest products in the swamps, charcoal making is also carried on by contract. The boss who is adept in charcoal-making usually sells his product at an average rate of ₱1.40 per sack at the point of production, ₱2 if he delivers it at the railroad station of Laguimanoc, or ₱2.25 at Tutuban, Manila.

In the preparation of the charcoal, the boss spends for labor ₱4.50 per cord of wood, which is equivalent to 10 sacks in charcoal or an average expense of ₱0.45 per sack. Adding to this the cost of packing, which is usually 2 centavos per sack, the total cost of preparation is 47 centavos a sack.

From point of production to Laguimanoc Railroad Station, the transportation expense incurred by the boss is 20 centavos per sack, and if sent to Tutuban, Manila, the expense incident is 20 centavos per sack.

Taking all these different factors into consideration, the net earnings of the boss per sack runs thus: ₱0.93 at place of production, ₱1.33 at Laguimanoc, and ₱1.38 at Tutuban.

One kiln holds 3 cords of firewood which, when turned to charcoal, will average 30 sacks of good charcoal. It takes about 10 days to make a batch of charcoal or an average of 3 kilns per month. The boss's monthly earnings then will be his share of the 90 sacks of charcoal turned out of every kiln. This is further illustrated in the following table:

Net earning per sack in different places of delivery.	Net earning per month for 90 sacks.
₱0.93 in point of production	₱83.70
₱1.33 delivered at Laguimanoc Railroad Station	119.70
₱1.38 delivered at Tutuban	124.20

From the above, it can be seen that the farther the distance the charcoal is delivered to the licensee the more money the boss can earn. But this is not all, one boss with the assistance of 4 laborers who are paid ₱2 each per day, can keep five ovens burning constantly.

The following statements show the possible monthly earnings of an expert boss managing five kilns at a time with the assistance of a crew of 4 men.

In the place of production:	
5 kilns with an average of 450 sacks of charcoal, at ₱0.93	₱418.50
4 laborers, at ₱2 per day	240.00
Monthly earning	178.50

At the railroad station, Laguimanoc:	
5 kilns with an average of 450 sacks of charcoal, at ₱0.93	₱418.50
4 laborers, at ₱2 per day	240.00
Monthly earning	358.50

At the railroad station at Tutuban, Manila:	
5 kilns with an average of 450 sacks of charcoal, at ₱1.38	₱621.00
4 laborers, at ₱2 per day	240.00
Monthly earning	381.00

In the foregoing earnings of the boss, occasional and personal expenses of his own or his agent administering the conduction of the charcoal to the points of destinations have not been included, due to lack of information regarding same. However, if there is such an agent, it is safe to state that he would not earn more than ₱60 per month, which amount should be deducted from the monthly earnings of the boss in the different places of delivery.

If the licensee himself is to transport the charcoal from the place of manufacture to Manila, he will incur the following expenses per carload of 130 sacks:

Cost of 130 sacks, at ₱1.40 from place of making	₱182.00
Transportation to railroad station, at ₱0.20 per sack	26.00

Freight charge on 130 sacks (J type car)	₱26.00
Forest charges (21 cu. m.)	8.40
Unloading and transportation on car to store of purchase	10.48
Total expenses	252.80
Wholesale price in Manila of 130 sacks, at ₱2.50	325.00
Total expenses for 130 sacks	252.80
Total gain of the licensee	72.00

If the licensee can ship to Manila the whole output of 5 kilns every month, he will then have an average of 3 cars of charcoal monthly, or a gain of ₱216.60 a month.

In Manila the charcoal is sold by retailers, at ₱0.10 per kilo. One sack contains from 30 to 37 kilos, depending upon the way the charcoal is packed in the sack and upon the species used. Thus the dealers are gaining from ₱0.50 to ₱1 per sack of charcoal sold. This information refers to the mangrove species only.

One J type freight car will hold 130 sacks of charcoal and the freight charge on same is about ₱25.

From the above, the cost of building the kilns for at least ₱100 each and the cost of bags for ₱0.20 each have not been taken into account; these are borne by the licensee.

Violations.—The cutting of small trees of bakauan, tangal, and langarai below the diameter limit is the most noticeable violation observed in practically all the swamps traversed from Pagbilao to Macalelon. Due to this is the present poor stand of the best species (bakauan and tangal especially), which have suffered much cutting in the past. It will no longer be a paying proposition for big licensees if they are required to stick to the diameter rules for the above species. In order to suit the commercial necessities of the licensees in this particular region, it is advisable to turn all ordinary licenses into license-agreements, whereby the licensees are allowed to operate under no restriction of the diameter limits, but are obliged to replant all over-cut areas with selected species that forest officers may designate, although ordinary licenses with due restrictions and close supervision are also good. In so doing, we will not only improve the stand growing in the swamps, but also prevent the licensees from exterminating the most desirable species and at the same time hinder them from disregarding the cutting rules. If these remain in force as at present the work will require stricter and closer supervision, which means much effort on the part of the Bureau of Forestry, otherwise our swamps will be depleted of desirable species.

As in the past, it is still a practice of some of the licensees to accept compensation from others for permission to gather forest products in their license areas.

Some of the licensees have procured their licenses through fraud and misleading statements.

The above violations by some of the present licensees, which are in violation of Section 4, paragraphs (*h*), (*i*); and (p. 3) of the Forest Regulations, can be attributed to the fact that some licensees have other more important business to attend to, wherefore they neglect the supervision of their cutting operations, while others merely take a license with the idea of profiting from it without investing any capital.

Some invoice timbers cut outside of their areas, especially species that do not exist in quantity in the swamps covered by their licenses, in order to avoid paying the additional forest charge of 100 per cent. Some transport their firewood from the cutting areas to Lucena and Pagbilao without first invoicing same, which is an open violation of Section 3 of the Administrative Order No. 42. This firewood sometimes is sold in Lucena for local consumption. When this is the case, the consequence is that the corresponding forest charges are not paid at all.

Vegetation.—The vegetation and condition of the swamps as observed can be divided into three classes and is distributed in the municipalities as follows:

1. Commercial forest comprises approximately 2,700 hectares or 74 per cent of the total area of the swamps. This is the forest where firewood and timber can be obtained in commercial quantity.
2. Non-commercial forest comprises approximately 907 hectares or 25 per cent of the total area of the swamps. This is the forest where firewood and timber can not be obtained in commercial quantity.
3. Nipa comprises approximately 22 hectares or 1 per cent of the total area examined.

The following table shows the approximate distribution of the mangrove swamps in the five municipalities:

Names of municipalities.	Commercial forest in hectares.	Non-commercial forest in hectares.	Nipales in hectares.
Pagbilao	823.50	275.00	1.50
Laguimanoc	576.50	192.00	0.50
Unisan	335.00	113.00	6.00
Pitogo	477.00	161.00	6.00
Macalelon	488.00	166.00	8.00
Total areas	2,700.00	907.00	22.00

Valuation surveys of 7.94 hectares were taken between creeks and rivers, in the representative stands from these areas. By representative stand is meant the stand where few or no cuttings have been made. Strip and plot methods of valuation surveys were used in determining the composition and approximate stands of the forest. The average number of trees per hectare is 1,656, with an average volume per hectare of 158.06 cubic meters, mostly of firewood with very little timber.

The stand tables which are attached to the reports of the individual compartments show that the condition of the stands per hectare of the swamps from Pagbilao to Unisan is poor and according there can be cut from 200 to 3,000 trees, or 27 to 130 cubic meters, per hectare chiefly firewood, with very little timber. This is due to the heavy cuttings of the desirable species. The condition of the swamps in Pitogo and Macalelon is still good and the stand per hectare ranges from 4,000 to 7,000 trees, or 200 to 500 cubic meters. This condition is due perhaps to the slow movement of the business in this locality, attributed to the difficulty of transportation.

Composition of the forest.—The species found in these swamps are listed below in order of their abundance:

Langarai (*Bruguiera parviflora*) is a tall, slender tree. It is found in many places in the interior of the swamps in pure stands and rarely at the bank of the rivers. It is also found mixed with api-api (*Avicennia officinalis*) and with other species of *Bruguiera*. In virgin swamps, it is represented by 451 trees, or 66 cubic meters, to the hectare. The biggest specimens are found in the swamps of Pitogo and Macalelon, reaching about 40 centimeters in diameter and over 15 meters high.

Tan̄gal (*Ceriops tagal*) is found in pure stands in the interior of the swamps, usually next to langarai, although it is sometimes found growing mixed with other species along the river banks. Due to the heavy cuttings made by licensees in the past, the remaining trees are almost all poles and seedlings. The biggest specimens of this species are found between Tuna and Macalelon Rivers, reaching 15 centimeters in diameter and about 5 meters in height. Only slightly cut-over areas, there were found 496 trees per hectare, with a volume of 21 cubic meters.

Bakauan (*Rhizophora candelaria* and *R. mucronata*) is found growing at the outer edge of the swamps, along the banks of the rivers and creeks and rarely on the seacoast. It is seldom found mixed with other species in the interior. The majority of the trees noted are short boled, crooked, and branchy, due perhaps to the abundance of light they receive. Among other species found near the banks, there were found 357 trees of bakauan per hectare, with a volume of 20.91 cubic meters. The biggest specimen noted was about 35 centimeters in diameter. Bakauan is rarely cut by other licensees than the charcoal makers.

Tabigi (*Xylocarpus granatum*) abounds near the banks of the upper course of the rivers and creeks associated with other species. Piagau (*Xylocarpus moluccensis*) is also found here, being called locally tabiging-itim. The former differs from the latter in that its trunk is usually crooked and very often rotten and its bark is smooth and light-colored, while the latter has a straighter and taller bole, with dark flaky bark. In the zone where tabiging-itim is found, it reaches 40 centimeters in diameter with a height of 9 meters. Of the two species there is an average stand of 103 trees, or 13 cubic meters per hectare. Tabiging-itim is used locally for house posts. The bark of tabigi is gathered for tanning purposes.

Busain and pototan (*Bruguiera conjugata* and *B. sexangula*) are found scattered in every part of the swamps, but sometimes they appear in larger numbers with other species in the upper parts of the streams. Not much cutting has been made of these species. However, many of the trees with the bark stripped off were noted. The biggest specimens noted were 45 centimeters in diameter with a length of 15 to 20 meters. In virgin forests there is a stand of 45 trees, with a volume of 11.28 cubic meters per hectare.

Buta-buta (*Excoecaria agallocha*), locally known as lipata, is a poisonous tree commonly found at the inner edge of the swamps. It has milky sap. It is said that if a small drop of the sap get into the eye, it will cause blindness. Nothing has been learned of the use of this tree. The biggest specimen noted was 25 centimeters in diameter with a length of 10 meters. There is a stand of 61 trees, with a volume of 1.60 cubic meters per hectare.

Api-api (*Avicennia officinalis*) is found along the upper edges of the swamps. In some places it is also found along the coast. In such places it is almost in pure stands. It is also found occupying cut-over areas, if immediate natural reproduction of other species has not taken place. This species is not being cut for any use. The bole is usually short, although there is occasionally one that reaches 10 meters in height. The biggest diameter noted during the studies is 100 centimeters. The stand, including perhaps other species of the same genus, amounts to 55 trees per hectare, with a volume of 12.14 cubic meters.

Saging-saging (*Aegiceras corniculatum*) is a small tree or shrub which is found along stream banks in the inner part of the swamps. Nothing has been heard of its use. There are about 41 trees per hectare, with a volume of 1.91 cubic meters.

Duñgon-late (*Heritiera littoralis*) grows on the inner part of the swamps. This is locally used for house posts. The largest specimen noted was 35 centimeters in diameter with a length of 8 meters. There is an average stand of 17 to the hectare, with a volume of 2.49 cubic meters.

Tabau (*Lumnitzera littorea*) is a tall tree found in very limited numbers, widely scattered along river banks in these swamps. Very few, if any, have been cut of this species either for local or commercial use. The largest specimens recorded reach 50 centimeters in diameter with a height of 10 meters. There is a stand of 17 trees, with a volume of 6.19 cubic meters per hectare.

Tawalis (*Osbornia octodenta*) grows at the outermost edge of the swamps along stream banks. It is characterized by its crooked trunk. This is cut for posts and is said to last long in the ground. The largest specimens were found in the swamps of Macalelon reaching 40 centimeters in diameter with a length of 5 meters. There are about 8 trees, with a volume of 0.94 cubic meters, per hectare.

Nilad (*Scyphiphora hydrophyllacea*), locally known as sagasa, is a shrub growing along stream banks in the swamps. It is rather scarce. No firewood is obtained from it. The biggest specimen recorded was 20 centimeters in diameter. There are about 3 trees per hectare, with a volume of .19 cubic meter.

Pagatpat (*Sonneratia caseolaris*) is seldom found in these swamps. It is practically absent in the swamps of Pitogo and Unisan and exceedingly rare in the swamps from Pagbilao to Unisan. The trees recorded are all of medium size. They amount to only 2 trees per hectare, with a volume of 0.50 cubic meter.

Nipa (*Nipa fruticans*) is a palm found growing in small numbers in narrow patches along the river banks, near and about the inner edges of the swamps. It is also often found along the outer edges of coconut groves. These nipas are practically all claimed by private individuals, but judging from the actual condition of the plants, it seems to indicate that they grow there naturally and it was perhaps through utilization and possibly a little clearing made around them that they look somewhat improved. The actual condition of these nipas is very poor. They have been deprived of their leaves. There are but 2 or 3 leaves left on most trunks, which can hardly keep them alive. No further information has been obtained regarding nipa, inasmuch as it is only gathered by the needy persons for personal use.

Possible Annual Cut.—After considering all factors that may lead to the slow annual growth of this forest, it can be conservatively estimated that the annual increment of all species preferred for firewood will not be less than 5 per cent of their present average stand of 119.05 cubic meters, that is, 5.95 cubic meters per hectare. (The species include in this estimate are bakauan, tañgal, langarai, and pototan.) As has been stated in the preceding table, the approximate total area of commercial swamps is 2,700, therefore the approximate possible total annual increment will be 16,065 cubic meters. If the licensees occupying these swamps will only cut merchantable sized trees to this amount for firewood per annum, it is supposed that the forest will not be impaired nor depleted of the best species. On the other hand, the oppressed young trees will not only be given space, but they will receive the necessary light for faster growth.

Reproduction.—The reproduction of almost all the mangrove species in these swamps is, in general, prolific, except in newly cut-over areas and a few places which the natural dissemination of seeds has failed to reach. So far, none of the licensees have practiced any planting and all restocking of cut-over areas and open spots is left in the hands of Nature.

The season of heavy seeding of the mangrove species in this region was not observed by the party during its stay in this province. However, it is believed that it takes place during the months of April and May, although light seedings of some of the trees of various species was noted in almost all the areas throughout the year.

In places where langarai is found in almost pure stand, there were counted from 3 to 10 seedlings of langarai, with 1 or 2 seedlings of other species, per square meter, or 30,000 to 100,000 seedlings up to 3 meters in height to a hectare. This is also true of tañgal. But these are exceptional spots where the reproduction is good in a zone along the bank of the streams, but very poor in the interior of the forest. Pototan has a poor reproduction, despite the fact that it produces plenty of healthy mature fruits. It is believed that its failure is due to the enemies of the seeds when dropped in the ground. Crabs are said to eat the seeds. Api-api has excellent reproduction in the drier places and from poor to fair when it takes the place of better species in cut-over areas. Tabigi and others species have poor reproductions in almost all the areas.

Remarks and Recommendations.—For the better management and conservation of forest resources, it is necessary that a definite plan be followed with the end in view of placing all mangles in the Philippine Islands under the absolute control of the Bureau of Forestry. Unless such a step is taken, the private claimants will remain always as a menace and a burden to the administration of public forest in the Philippines. As a first step in this direction, all mangrove areas covered in the reconnaissance should be studied with a view of declaring same as forest zones, thereby bringing the administration of said swamps more directly under a stricter supervision than they are at present. In this case, claimants will have to fight for their claims in order not to be excluded from the forest zone proposed, instead of the Bureau doing the fighting, which is in many cases difficult and costly, if not entirely a failure.

For the increasing local demands for fish, which at present can hardly be supplied by fish trapped in the fish-corrals in the sea, which deficiency can only be remedied by converting mangroves into fishponds, it is recommended that all cut-over swamps near towns and railroad stations, which, due to their nearness to the shipping points render them more desirable for fishponds, be approved for this purpose with the usual restrictions contained in the fishpond agreements.

All comparatively dry swamps adjoining cultivated lands, which are mostly occupied by api-api and other undesirable species and which are less affected by the tide, are recommended for nipa plantations and salt-works.

ADMINISTRATIVE DIVISION.

GENERAL STATEMENT.

The work of this division involves the general supervision of all the clerical work of the Bureau, the keeping of efficiency and civil service records of the employees the direct control of the records of the Bureau, the preparation of estimates for the annual appropriation and supervision over its distribution, the care of the property, the control of the clerks in the provinces, the upkeep and maintenance of the office building, the supervision of the general section and the general administration of the office, including the preparation of such letters appertaining to other divisions as well as to its own.

The correspondence received in this office during the year has increased enormously due to the increase in personnel and in the increase of activities in the lumber industry; but on the other hand, clerical personnel has not increased at the same rate thus overworking the scanty clerical personnel in this Bureau. Attempts have been made to remedy this situation but unfortunately, due to the scarcity of funds, it has not been possible to secure the desired number of additional clerks or to promote those that were competent and deserving of higher pay.

In June of this year, at the suggestion of the Insular Auditor, the Cashier and Disbursing Officer was placed directly under the chief of this division.

RECORD SECTION.

The loss in the Bureau of experienced clerks due to low salaries paid them has been felt acutely during the year, especially in the Record Section, but as there is no way to remedy the situation for lack of funds, the work in that section has been handled by mediocre clerks. It is, therefore, apparent that a change must be made in order to give this section its due recognition and to properly compensate the positions in it as well as the present employees who are doing their best to carry on the work, and to increase their number in order to relieve the present overburden of work and to safeguard the records of the Bureau. In other words, higher pay for positions in this section is desired in order to secure the services of experienced clerks in this line of work.

DISTRICT CLERKS.

It has been difficult to secure clerks for the district stations. Repeated efforts to secure civil service eligibles for work in the provinces have produced no results because the salary which this Bureau is authorized to pay did not appeal to these clerks. As a result, forest officers who are paid ₱90 to ₱120 a month are laboriously writing their own correspondence or else local clerks with little training have been employed on a temporary basis. Either method is wasteful but until higher pay can be offered to clerks there is no relief in sight.

GENERAL SERVICE SECTION.

The chauffeur, messengers, janitors, and watchmen come under this section. The work in this section has been carried on satisfactorily throughout the year both in the messenger service and in the maintenance and upkeep of the building and court yard of this Bureau.

It is, however, desired that funds be made available for the appointment of additional messengers as the present number of messengers allowed in this Bureau is by no means sufficient to answer the demand for messenger service in this office.

DIVISION OF ACCOUNTS AND PROPERTY.

The work of this division is carried on in three sections, namely: Auditing accounts, property, and library.

AUDITING SECTION.

An effort will be made to secure authority to appoint a clerk as chief of this section in order that the incumbent may devote all his time to his duties as cashier. The increase in the force of forest guards will necessitate an increase in the clerical force in order to expedite the issuance of pay checks and the auditing of expense accounts.

PROPERTY SECTION.

The work of receiving and distributing supplies to the field force has been carried out as well as the funds available would permit. Additional storage space was acquired but this building cannot be used to advantage until the shelves and lockers have been installed. This work will be undertaken next year if possible.

LIBRARY AND TRANSLATION SECTION.

Books have been purchased for use in the Forest School and there has been the usual addition to the library of technical journals and publications. In addition to his regular duties, the chief of this section was detailed for several months as instructor in Spanish for two days a week at the Forest School.

CONCLUSION.

The Legislature seems to have established it as a rule, in considering the budgets of the Bureau of Forestry, to take into account the amounts of forest charges collected, the result being that not only the future of this Bureau, but even its present existence and the success of the work entrusted to it, depend entirely on the collection of forest charges; if this be true, nothing can be more erroneous and unjust, if it be kept in mind that under the present system of collection, which is not under the control of this office, the Government is defrauded of over 40 per cent of the charges that should legally be collected, but which are not collected on account of the incorrect classification of lumber within the respective groups and on account of the lack of supervision over products transported with or without the warrant of law.

The Bureau of Forestry can hardly fulfil with any satisfactory degree of efficiency the duties the law assigns to it without increasing the appropriation for personnel and running expenses and without a more direct control of the assessment and collection of forest charges, inasmuch as these latter bear a most intimate relation to the success of the work of this Bureau.

The arguments set forth during the successive preceding years by this Bureau regarding the difficulty, almost the impossibility, of retaining its personnel, technical as well as clerical, are repeated with greater emphasis this year, for the situation arising from the frequent resignations demands that preferential attention be given to the matter of the personnel of this Bureau, in order to prevent the loss of efficiency, which, with the continuance of the present state of affairs, must inevitably result.

Since 1912, when the first forest pensionados completed their two-year course of training in the Forest School at Los Baños, up to 1920, the Legislature has been appropriating the necessary amounts for the employment in the Bureau of Forestry of those who graduate every year, and it was only in the budget for 1921 that, for the first time, the necessary amounts were not provided in the appropriation for the employment of the fifteen new graduates, in spite of the fact that this appropriation was requested through several different ways.

The lack of this appropriation has entirely upset not only the future projects for the performance of which this Bureau depends upon the graduates of every year, but also the present organization, because in order to prevent the disastrous moral effect which will result in not giving employment to the new graduates after so much advertisement and efforts exerted to secure pensionados, this Bureau will be obliged to dismiss about thirty-five forest guards who are actually paid with the savings from vacant positions and whose services are likewise necessary for the scaling of logs in the sawmills and for patrol work in order to prevent caiñgin making and other forest violations.

Another important service which is affected by the continuous resignation of rangers is that of land classification, inasmuch as owing to the necessity of dismissing the forest guards who replaced them, a great many of the rangers selected and trained for the classification of land on a large scale will be detailed again to the field stations and this will undoubtedly cause great delay in the certification of lands in the regions where it has been requested by the Director of Lands.

Out of the 192 rangers graduated from the Forest School at Los Baños since 1912, there remain in the service only 122, for which reason this Bureau will urgently request that University of the Philippines increase to not less than thirty-five the number of pensionados per year during a period of about five years in order to supplement the evident shortage of this personnel. For the purpose of temporarily overcoming the shortage of field personnel, this Bureau strongly recommends the approval of the plan which is now being studied to organize a body of forest guards with a total of two hundred men on a permanent basis and of third grade Civil Service standing which will be included in the appropriation estimates for next year. These guards will be detailed for patrol work and also as assistants in administrative work in order to make more efficient the collection of forest charges by a more frequent intervention of the field staff in this line of work; thus the rangers will be available for other more important technical work in the line of their training.

As regards the higher technical personnel the same recommendations given in previous years are here repeated: That the salaries of these men should be commensurate to the importance of their work and positions and must be placed in the same level as those of other scientific branches of the Government.

Finally, there is recommended a proportional increase of the clerical personnel both in number and salaries; the Forest School and the Division of Investigation should be provided with additional buildings and equipment in order to inaugurate adequately the higher course of forestry, to carry out the research work, and to provide residences for the students and faculty of the school.

RAFAEL MEDINA,
Acting Director of Forestry.

The SECRETARY OF AGRICULTURE
AND NATURAL RESOURCES,
Manila.

APPENDIX

STATISTICAL TABLES.

TABLE NO. 1.—*Statement of the public lands applications received from the Bureau of Lands and of the certification made to the same regarding the agricultural or forest value.*

Provinces.	Received from the Bureau of Lands.									Certification made to the Bureau of Lands.			
	Pending from previous year.				During the year 1920.				Total.	Agriculture.			
	A. C.	H.	P.	L.	A. C.	H.	P.	L.		A. C.	H.	P.	L.
Abra		2	1			1	1		5		1		
Agusan		62	10	5		12			89		19	7	2
Albay		104	10			4			118		29		
Ambos Camarines		236	38	4		32			310		65	15	
Antique		36	2						38		34	2	
Bataan		44	15	6		18			83		32	4	2
Batanes						1			1				
Batangas			5						5			5	
Bohol		13	1	2		2			18		3	1	
Bukidnon		13		1					14		11		
Bulacan		4				1			5		2		
Cagayan		72	27			29			128		58	23	
Capiz		14	1			8			23		3		
Cavite													
Cebu		16	3	3					22		2	1	
Cotabato		408	10	18		6		1	443		178	2	3
Davao		279	81	65		18			393		126	21	17
Ilocos Norte		4	4						8		2	1	
Ilocos Sur		18	8			12			38		8		
Iloilo		13	4	1		1	1		20		10	1	
Isabela		130	10			19			159		89	3	
Laguna		15							15		1		
Lanao		58	5	2		21	1		87		42	4	1
La Union		83	1	1		3			88		14	1	
Leyte		192	9			21			222		46	2	
Mindoro		310	25	8		122	19		484		63	8	6
Misamis		8				3			11		4		
Mountain		32	1	1		5			39		11		
Negros Occidental		162	6	5		17		1	191		90	5	3
Negros Oriental		16	1			2			19		6		
Nueva Ecija		381	78	32		169	2	3	660		378	43	30
Nueva Vizcaya		72	10	5		28			115		58	3	2
Palawan		54	5	1		18	1		79		28		
Pampanga		50	4	1		7		1	63		33	3	1

Pangasinan	....	143	18	3	....	34	....	....	193	....	92	11	1
Rizal	....	9	....	1	....	6	....	....	16	....	12	....	....
Romblon	....	12	4	....	....	11	....	....	27	....	4	....	....
Samar	....	35	2	....	....	1	....	....	38	....	4	....	....
Sorsogon	....	87	10	....	....	17	1	1	116	....	13	5	....
Sulu	....	....	....	....	....	1	....	1	2	....	1	....	....
Surigao	....	27	1	....	....	2	....	....	30	....	8	....	....
Tarlac	....	22	13	1	....	82	5	....	128	....	38	13	....
Tayabas	....	818	56	4	....	350	20	1	1,249	....	339	18	....
Zambales	....	52	17	9	....	16	....	....	94	....	26	11	1
Zamboanga	....	146	14	2	....	31	....	....	193	....	84	12	1
Total	....	4,197	445	181	....	1,181	51	9	6,014	....	2,061	225	70

STATISTICAL TABLES—Continued.

TABLE No. 1.—*Statement of the public lands applications received from the Bureau of Lands and of the certification made to the same regarding the agricultural or forest value*—Continued.

Province.	Certification made to the Bureau of Lands.					Returned to the Bureau of Lands uncertified during the year 1920.				Total pending for inspection December 31, 1920.				
	Forestry.				Total.									
	A. C.	H.	P.	L.		H.	P.	L.	Total.	A. C.	H.	P.	L.	Total.
Abra					1						2	2		4
Agusan		8	1		32	3	1		4		49	1	3	53
Albay		22	2		53						57	8		65
Ambos Camarines		36	2		118	7	1		8		160	20	4	184
Antique		1			37						1			1
Bataan					38						30	11	4	45
Batanes											1			1
Batangas					5									
Bohol					4						12		2	14
Bukidnon					11	1			1		1		1	2
Bulacan					2						3			3
Cagayan		1			77	11	3		14		36	1		37
Capiz					3						19	1		20
Cavite														
Cebu		4			7						10	2	3	15
Cotabato					183	2			2		229	8	16	253
Davao		1	1	5	171	6	2	16	24		164	7	27	198
Ilocos Norte					3						2	3		5
Ilocos Sur		2	1		11		1		1		20	1		21
Iloilo		2	1	1	15		1		1		2	2		4
Isabela					92	1			1		59	7		66
Laguna					1	3			3		11			11
Lanao		7			54	2			2		28	2	1	31
La Union		1			16	1			1		20		1	21
Leyte		7			55	11	2		13		149	5		154
Mindoro		9			86	149	27	2	178		211	9		220
Misamis					4						7			7
Mountain		3		1	15	4			4		19	1		20
Negros Occidental		43			141	11	1		12		35		3	38
Negros Oriental		5			11	1	1		2		6			6
Nueva Ecija		25	1		477	14	2	1	17		133	29	4	166
Nueva Vizcaya					63	8		3	11		34	7		41
Palawan		3		1	32	2			2		39	6		45
Pampanga		7			44	3			3		14	1	1	16
Pangasinan		18	1		123	9			9		58	1	2	61
Rizal					12						3		1	4
Romblon		6	1		11						13	3		D—16

Samar	....	1	1	....	6	....	....	....	....	....	31	1	....	32
Sorsogon	....	31	1	....	49	1	....	....	1	....	60	5	1	66
Sulu	....	....	....	....	1	....	....	....	....	....	....	....	1	1
Surigao	....	....	....	....	8	1	....	....	1	....	20	1	....	21
Tarlac	....	7	....	1	59	4	2	....	6	....	55	3	....	58
Tayabas	....	137	9	1	504	45	4	....	49	....	647	45	4	696
Zambales	....	7	1	....	46	8	1	....	4	....	32	4	8	44
Zamboanga	....	14	....	....	111	6	....	....	6	....	73	2	1	76
Total	....	408	23	10	2,792	809	49	22	880	....	2,555	199	88	2,842

STATISTICAL TABLES—Continued.

TABLE NO. 1.—*Statement of the public lands applications received from the Bureau of Lands and of the certification made to the same regarding the agricultural or forest value*—Continued.

Fiscal year.	Agricultural colonies.			Homesteads.			Sales.			Leases.			Grand total.
	Agri-culture.	orest.	Total.	Agri-culture.	Forest.	Total.	Agri-culture.	Forest.	Total.	Agri-culture.	Forest.	Total.	
1905				80	6	86	8		8				94
1906				318	16	334	20	1	21	1		1	356
1907				881	19	900	23		23	12		12	935
1908				2,456	51	2,507	49	1	50	26		26	2,583
1909				1,523	187	1,710	26	3	29	27		27	1,766
1910				1,175	385	1,560	34	5	39	42	2	44	1,643
1911				1,528	221	1,749	46	3	49	30	1	31	1,829
1912				2,609	301	2,910	95	11	106	47	1	48	3,064
1913				2,680	269	2,949	104	30	134	47	1	48	3,131
1913 (July 1 to December 31)				1,653	159	1,812	81	16	97	41	3	44	1,953
1914				4,812	685	5,497	279	36	315	77	1	78	5,890
1915	1,086	28	1,114	5,965	688	6,653	317	52	369	70	1	71	8,207
1916	934	41	975	6,015	670	6,685	227	18	245	55	4	59	7,964
1917	670		670	7,632	797	8,429	457	27	484	118	6	124	9,707
1918	41		41	5,605	621	6,226	420	33	453	109	16	125	6,845
1919				5,256	790	6,046	431	51	482	137	22	159	6,687
1920				2,061	403	2,464	225	23	248	70	10	80	2,792
Total	2,731	69	2,800	52,249	6,268	58,517	2,842	310	3,152	909	68	977	65,446

NOTE.—A. C. = Agricultural Colony of 16 hectares lot; H. = Homestead; P. = Purchase; L. = Lease.

SUMMARY.

Applications on hand during 1920		6,014
Certified for agriculture	2,356	
Certified for forestry	436	
Returned uncertified	380	
		3,172
Total pending December 31, 1920		2,842

TABLE NO. 2.—*Statement showing amounts in cubic meters of important timbers, by species cut and invoiced in the Philippine Islands during the fiscal years 1910 to 1920.*

Species.	Fiscal year—			
	1910	1911	1912	1913
Red Lauan	...	...	...	...
White Lauan	48,489	46,942	57,086	81,469
Apitong	20,764	21,096	28,929	32,391
Tangile	2,106	2,762	3,999	5,249
Guijo	14,107	14,231	18,579	17,279
Yakal	8,225	8,150	14,491	21,770
Ipil	13,717	12,296	17,237	15,791
Molave	8,923	7,978	9,091	9,363
Narra	5,744	4,996	8,474	8,877
Kalantas	3,174	1,368	938	3,320
Palosapis	...	...	...	...
Manggachapuy	...	...	...	...
Dungon	2,453	1,693	1,218	981
Tindalo	954	1,018	794	982
Akle	809	867	1,295	1,690
Lumbayao	...	...	...	...
Pagatpat	...	...	...	...
Other species:				
First group	574	322	707	1,000
Second group	1,667	6,644	7,988	8,548
Third group	8,316	10,927	11,796	8,711
Fourth group	36,786	41,655	42,981	59,855
Total	176,758	182,945	225,548	277,171

Species.	July 1 to December 31, 1918.	Fiscal year—		
		1914	1915	1916
Red Lauan	...	...	...	...
White Lauan	20,249	74,458	73,277	107,684
Apitong	12,905	32,328	38,849	56,529
Tangile	8,390	14,682	15,460	28,961
Guijo	7,841	19,701	15,650	16,685
Yakal	5,593	15,115	14,714	16,471
Ipil	7,535	17,602	12,089	14,147
Molave	4,783	9,753	10,546	10,788
Narra	3,941	8,467	9,868	7,970
Kalantas	886	2,423	1,999	4,574
Palosapis	...	2,222	1,631	2,728
Manggachapuy	...	1,469	1,859	2,666
Dungon	601	2,199	1,467	1,127
Tindalo	484	914	1,181	1,115
Akle	729	1,287	1,498	1,088
Lumbayao	...	...	...	...
Pagatpat	...	...	...	...
Other species:				
First group	687	2,196	2,190	3,074
Second group	8,266	9,873	6,940	7,988
Third group	2,999	7,557	6,920	5,214
Fourth group	25,613	73,017	60,130	56,738
Total	101,502	294,758	276,268	341,442

TABLE NO. 2.—*Statement showing amounts in cubic meters of important timbers, by species cut and invoiced in the Philippine Islands during the fiscal years 1910 to 1920*—Continued.

Species.	Fiscal year—				Total, 1910 to 1920.
	1917	1918	1919	1920	
Red Lauan	....	....	....	52,294	52,294
White Lauan	131,699	108,900	180,556	119,883	1,045,487
Apitong	55,835	56,274	72,228	99,775	523,398
Tangile	25,389	21,775	35,005	40,903	199,681
Guijo	16,857	17,301	25,924	28,418	212,568
Yakal	11,963	9,162	18,100	20,317	164,071
Ipil	16,629	15,498	18,926	24,720	186,187
Molave	13,582	22,233	26,088	30,173	163,301
Narra	5,904	7,848	11,152	12,711	95,952
Kalantas	7,381	4,975	5,040	8,622	44,700
Palosapis	3,042	8,868	15,661	7,594	41,736
Manggachapuy	2,916	2,214	3,096	3,094	17,814
Dungon	1,592	1,818	1,839	2,607	19,040
Tindalo	1,145	826	1,080	1,887	11,830
Akle	798	870	987	2,047	13,915
Lumbayao	6,085	4,415	4,192	7,550	22,242
Pagatpat	1,502	849	2,766	4,743	9,860
Other species:					
First group	1,084	1,416	3,335	9,104	25,689
Second group	6,432	7,779	12,084	17,414	101,068
Third group	9,895	8,611	53,518	1,978	136,437
Fourth group	47,661	80,988	3,711	59,718	588,798
Total	366,891	382,060	495,228	554,997	3,675,568

TABLE NO. 3.—*Revenues derived from the sale of forest products and expenditures of the Bureau of Forestry since its organization, April 14, 1900.*

Fiscal year.	Revenue.	Expense.	Surplus.	Expense.
				Per cent.
1901 to 1906	₱2,268,591	₱1,118,887	₱1,149,704	49
1907	191,080	105,050	86,030	55
1908	211,571	107,242	104,329	51
1909	251,880	115,049	136,831	45
1910	271,582	152,161	119,421	56
1911	334,763	160,476	174,287	48
1912	354,685	200,840	153,845	57
1913	390,664	227,048	163,616	59
1913 (July to December 31)	160,913	141,131	19,782	88
1914	442,661	256,990	185,671	58
1915	425,817	274,176	151,641	64
1916	494,447	285,708	208,739	58
1917	536,328	281,126	255,202	53
1918	650,692	334,254	316,438	51
1919	805,229	473,242	331,986	58
1920	1,009,879	541,488	468,390	54
Total	8,800,282	4,774,868	4,025,412	54.25

TABLE NO. 4.—*Revenues from sale of forest products, January 1 to December 31, 1920.*

Province.	Charges on forest products.								
	Timber.				Firewood.		Minor products.	Lease of forest lands.	Total.
	First group, ₱2.50 per cubic meter.	Second group, ₱1.50 per cubic meter.	Third group, ₱1 per cubic meter.	Fourth group, ₱0.50 per cubic meter.	Bacauan and tangal, ₱0.20 per cubic meter.	Other, ₱0.10 per cubic meter.			
Abra	₱3,452.25	₱1,276.05	₱694.73	₱237.28	₱32.76	₱122.50	₱191.60	....	₱6,007.17
Agusan	4,645.33	59.55	16.74	62.81	2.20	....	1,066.28	....	5,852.91
Albay	3,478.07	8,701.78	4,442.51	1,877.29	777.54	445.40	6,333.57	....	26,056.16
Ambos Camarines (first quarter only)	627.68	717.52	944.94	749.12	484.10	164.17	2,967.23	....	6,654.76
Antique	483.62	16.91	107.19	71.08	20.00	86.44	396.96	....	1,182.20
Bataan	449.59	2,579.11	9,054.52	7,262.74	599.34	1,220.86	2,938.94	....	24,105.10
Batangas	1,766.54	968.14	102.84	381.80	181.67	1,281.59	2,836.27	....	7,518.85
Bohol	1,099.27	222.33	139.08	311.07	1,151.68	925.15	927.46	....	4,776.04
Bukidnon	311.65	1.76	7.19	....	31.44	....	67.86	....	419.90
Bulacan	3,305.45	3,296.14	3,265.67	2,467.58	74.56	67.77	1,102.02	....	13,579.19
Cagayan	21,771.14	1,965.48	3,887.89	577.81	420.69	292.90	4,724.32	....	33,640.23
Camarines Norte	623.97	618.01	1,461.95	446.38	495.23	16.38	3,577.50	....	7,239.42
Camarines Sur	1,055.41	955.69	1,740.51	1,236.17	391.86	393.75	7,932.20	....	13,705.59
Capiz	607.76	366.04	1,776.73	1,828.03	3,024.39	832.38	1,063.31	....	9,498.64
Cavite	15.60	61.85	2.75	20.15	....	135.70	1,222.81	....	1,458.86
Cebu	1,198.96	251.08	541.47	470.57	3,785.30	1,717.79	4,335.31	₱86.81	12,387.29
Cotabato	15,966.97	13,036.78	1,137.69	1,321.14	2,276.73	37.32	5,309.51	....	39,086.14
Davao	5,012.75	2,791.27	4,928.54	6,092.64	547.30	401.14	4,281.91	....	24,055.55
Ilocos Norte	1,121.85	562.32	309.00	223.53	61.84	78.92	95.67	....	2,453.13
Ilocos Sur	262.46	21.26	25.35	15.92	2.80	93.73	247.28	....	668.80
Iloilo	7,924.40	3,796.18	2,755.38	1,342.61	2,692.74	2,618.58	4,341.79	16.58	25,488.26
Isabela	6,141.50	1,626.33	1,145.29	317.18	28.18	98.04	42.92	....	9,399.44
Laguna	216.11	942.61	2,861.51	627.80	23.70	546.10	1,589.95	....	6,807.78
Lanao	583.32	116.42	381.17	163.20	....	57.58	186.29	....	1,487.98
La Union	423.04	168.31	219.84	24.00	....	5.32	284.47	....	1,124.98
Leyte	3,165.13	1,838.51	7,053.72	8,033.27	1,490.21	64.98	4,471.55	....	26,117.37
Manila	93,828.39	15,575.38	120,808.84	55,919.69	1,901.61	2,065.69	9,652.70	141.71	299,894.01
Marinduque	187.05	231.94	56.88	13.39	181.58	54.52	269.60	....	994.96
Mindoro	4,044.56	1,464.36	655.32	1,367.87	762.40	404.87	2,855.78	....	11,555.16
Misamis	1,294.91	1,442.17	2,735.01	1,065.86	92.25	197.90	1,737.82	....	8,565.92
Mountain Province	1,940.79	294.62	5,976.20	226.88	....	1,615.90	539.00	....	10,593.39
Negros Occidental	7,295.74	6,273.71	5,039.30	5,813.14	1,462.57	777.94	5,488.61	....	32,151.01
Negros Oriental	2,036.23	612.89	465.73	315.13	78.12	248.60	3,244.98	....	7,001.68
Nueva Ecija	4,008.70	1,460.26	91.63	94.87	7.88	105.70	2,918.87	....	8,687.91
Nueva Vizcaya	152.73	17.96	2.55	....	9.00	....	117.77	....	300.01
Palawan	7,401.11	1,486.83	148.95	1,404.28	272.33	280.16	2,358.69	....	13,352.35
Pampanga	429.68	1,386.93	5,011.53	2,139.90	167.73	1,104.70	918.75	....	11,159.22

TABLE NO. 4.—*Revenues from sale of forest products, January 1 to December 31, 1920*—Continued.

Province.	Charges on forest products.								
	Timber.				Firewood.		Minor products.	Lease of forest lands.	Total.
	First group, ₱2.50 per cubic meter.	Second group, ₱1.50 per cubic meter.	Third group, ₱1 per cubic meter.	Fourth group, ₱0.50 per cubic meter.	Bacauan and tangal, ₱0.20 per cubic meter.	Other, ₱0.10 per cubic meter.			
Pangasinan	₱8,481.60	₱4,779.97	₱3,889.17	₱1,321.41	₱1,245.37	₱799.87	₱1,582.87	....	₱22,099.76
Rizal	241.82	351.22	212.09	521.06	10.00	1,165.73	2,748.25	....	5,245.17
Romblon	2,139.66	1,469.01	120.68	145.94	....	32.29	897.24	....	4,804.82
Samar	6,738.93	1,651.33	2,952.25	1,151.16	857.85	296.38	8,251.90	....	21,899.80
Sorsogon	25,405.44	4,656.05	3,484.27	6,601.48	2,244.26	488.66	4,587.57	₱100.00	47,567.73
Sulu	14,020.08	1,839.86	944.78	379.48	1,177.73	146.00	292.23	....	18,800.06
Surigao	1,895.35	486.20	415.83	254.59	9 60.06	....	3,625.82	....	6,746.85
Tarlac	925.44	227.54	55.54	63.46	....	85.94	515.45	....	1,823.37
Tayabas	52,612.96	4,391.04	5,797.62	2,307.45	6,771.60	8,711.18	23,400.89	10.50	104,003.24
Zambales	1,871.10	2,981.53	5,826.84	1,814.89	580.35	599.38	1,318.95	....	14,492.49
Zamboanga	8,437.22	5,744.55	20,505.23	6,582.08	1,776.15	738.52	4,690.78	....	48,474.48
Total charges	309,803.93	90,787.16	221,266.90	107,118.12	33,632.72	25,600.09	128,814.36	355.60	917,323.88
Total fines and penalties	30,805.88	10,036.17	12,926.54	13,050.56	4,031.83	5,924.23	15,780.04	....	92,555.25
Grand total	340,609.81	100,773.33	234,193.44 3	120,163.68	37,664.55	31,524.32	144,594.40	355.60	1,009,879.13

TABLE No. 5.—*Timber licenses in force during fiscal year 1920 (January 1, to December 31).*

Province.	Timber licenses.					Gratuitous licenses.				
	For less than 100 cubic meters.	For 100 cubic meters and less than 1,000 cubic meters.	For 1,000 cubic meters and over.	License agreements.	Total commercial licenses.	For personal use.		For public works.	Miner's gratuitous licenses.	Total.
						Inside communal forest.	Outside communal forest.			
Abra	27	63			90	35	12	1		48
Agusan	1	15	9	1	26	11	77	2	1	91
Albay	5	27	16		48	22	83	2		107
Antique	8	11			14	3	2	2		7
Bataan	38	14	35	2	89			2		2
Batangas	2	12	2		16		3	2		5
Bohol	18	11	1		30	168	13	2		183
Bukidnon			2		2	2	10	2		14
Bulacan	4	62	9		75		5	2	10	17
Cagayan	3	118	18		139	60	9	8	1	78
Camarines Norte	3	35	5		43	5	2	2	13	22
Camarines Sur	7	40	4	1	52	4	8	2	13	27
Capiz	8	71	1		80	17	7	2		26
Cavite	1				1		1	2		3
Cebu	14	22	2		38	15	38	2	2	57
Cotabato	2	2	6		10			2		2
Davao	27	37	19		83		31	2		33
Ilocos Norte	29	38	6		73	28		4		32
Ilocos Sur	8				8	12		4		16
Iloilo	6	30	3		39	1	5	2		8
Isabela	6	67	3		76	77	4	3		84
Laguna	12	48	5		65		13	2		15
Lanao		6	7	1	14			2		2
La Union	5	8			13	33		2		35
Leyte	34	76	6		116	128	212	2		342
Marinduque		14	1		15	12	1			13
Mindoro	10	48	34		92	1	15	2		18
Misamis	2	14	4		20	46	14	2		62
Mountain Province	65	37	15	2—1	110—8	9	18	6	3	36
Nueva Ecija	3	36	5		44	95	1	3		99
Nueva Vizcaya	16	8	2		26	11	17	3		31
Occidental Negros	2	48	26	2	78	6	1	2		9
Oriental Negros	1	12	5		18	4	8	2		14
Palawan	22	3	30		55		13	2		15
Pampanga		14	5		19		1	2		3
Pangasinan	6	97	11		114	184	8	2		194
Rizal	3	16	2		21		2	2		4
Romblon	2	11	1		14	6	20	2		28

TABLE NO. 5.—*Timber licenses in force during fiscal year 1920 (January 1 to December 31)*—Continued.

Province.	Timber licenses.					Gratuitous licenses.				
						For personal use.				
	For less than 100 cubic meters.	For 100 cubic meters and less than 1,000 cubic meters.	For 1,000 cubic meters and over.	License agreements.	Total commercial licenses.	Inside communal forest.	Outside communal forest.	For public works.	Miner's gratuitous licenses.	Total.
Samar	49	46	10	....	105	185	89	2	....	226
Sorsogon	10	81	43	....	184	16	29	2	10	57
Sulu	....	1	4	....	5	....	....	2	....	2
Surigao	36	24	5	....	65	88	169	2	8	262
Tarlac	....	14	2	....	16	81	3	2	....	86
Tayabas	17	85	72	1	175	32	3	2	6	43
Zambales	10	30	12	1	53	32	54	2	....	88
Zamboanga	17	18	25	5	65	52	94	3	1	150
All provinces	....	....	....	....	....	....	....	1	....	1
Total	534	1,470	478	15 ← [illegible]	2,493	1,481	1,045	103	68	2,692
Total 1919	1,078	1,548	315	14	2,950	547	605	200	68	1,415
Difference	—544	—78	+158	+[illegible] 1	—457	+934	+440	—97	....	+1,277

NOTE: + = increases; — = decreases.

In Cagayan, Isabela, Abra, La Union, Mountain Province, Nueva Vizcaya, Pangasinan, and Tarlac, 728 licenses were issued for building tobacco curing houses.

TABLE NO. 6–A.—*Report of utilization of forest products from public forest of the Philippine Islands during the fiscal year 1920 (January 1 to December 31).*

Province.	Timber.					Firewood class.		Charcoal.	Dyewood.
	Group.				Total.				
	First.	Second.	Third.	Fourth.		First.	Second.		
	Cu. m.	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Kilos.*
Abra	1,006	781	490	365	5,292	23	2,460	...	...
Agusan	1,870	105	23	49	2,047	...	34	2	...
Albay	2,355	1,801	3,190	1,358	8,704	2,315	1,738	11	...
Antique	59	63	20	65	207	92	52	...	...
Bataan	86	4,082	41,255	31,538	76,961	2,817	17,083	1,065	...
Batangas	191	63	14	68	336	8	19,888	...	...
Bohol	258	102	209	502	1,071	20,679	12,161	8	...
Bukidnon	163	16	5	5	189	...	...	...	...
Bulacan	908	1,688	1,933	3,133	7,662	73	722	495	...
Cagayan	7,655	746	3,365	836	10,002	438	2,038	...	...
Camarines Norte	261	229	1,652	524	2,666	3,164	3,289	...	...
Camarines Sur	1,646	2,100	10,311	2,748	16,805	1,190	2,892	...	...
Capiz	112	171	1,897	1,315	3,495	11,025	11,088	484	...
Cavite	...	...	...	25	25	...	9,597	19	...
Cebu	152	66	41	176	435	235	10,276	8	...
Cotabato	4,079	4,946	1,229	1,834	12,088	355	1,884	...	...
Davao	502	496	471	1,784	3,253	1,188	422	35	...
Ilocos Norte	416	412	301	459	1,588	88	329	2	...
Ilocos Sur	35	6	4	17	62	...	130	...	146
Iloilo	306	504	348	630	1,788	10,312	21,817	366	1,021,616
Isabela	2,001	907	1,028	503	4,439	...	634	...	...
Laguna	88	502	2,774	1,019	4,383	30	6,838	1,168	...
Lanao	119	337	23,194	10,485	34,135	13	229	5	...
La Union	149	91	91	18	349	...	23	...	27,305
Leyte	2,286	656	3,057	3,108	9,107	4,607	815	58	...
Marinduque	67	93	74	16	250	5,304	3,158	...	...
Mindoro	4,111	5,576	2,955	2,171	14,813	13,890	7,862	...	400
Misamis	495	310	1,382	653	2,840	271	936	...	...
Mountain Province	910	400	6,416	85	7,811	...	9,508	...	...
Negros Occidental	3,150	2,245	40,107	79,737	125,239	3,114	4,768	52	...
Negros Oriental	937	658	327	413	2,335	70	710	...	...
Nueva Ecija	945	834	164	186	2,129	...	4,522	67	...
Nueva Vizcaya	63	7	29	84	183	...	298	...	...
Palawan	22,028	2,614	251	721	25,614	161	42	...	...
Pampanga	42	635	970	455	2,102	222	4,477	305	...
Pangasinan	2,387	3,199	3,274	1,023	9,883	7,775	6,495	250	...
Rizal	33	89	68	472	662	...	29,240	2,792	...
Romblon	644	447	95	139	1,325	206	158	...	...

TABLE NO. 6-A.—*Report of utilization of forest products from public forest of the Philippine Islands during the fiscal year 1920 (January 1 to December 31)*—Continued.

Province.	Timber.					Firewood class.		Charcoal.	Dyewood.
	Group.				Total.	First.	Second.		
	First.	Second.	Third.	Fouth.					
	Cu. m.	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Kilos.*
Samar	2,260	614	1,378	1,015	5,267	3,142	116		
Sorsogon	12,698	3,281	2,719	4,741	23,439	6,256	4,764	2	
Sulu	3,528	881	681	363	5,453	2,809	4	250	
Surigao	605	826	441	191	1,563	2,058	440	20	
Tarlac	265	109	31	76	481	6	350	89	
Tayabas	21,915	2,297	24,201	3,347	51,760	481,718	49,790	506	
Zambales	654	1,849	6,709	3,902	13,114	2,243	4,023	86	
Zamboanga	4,691	4,244	25,663	17,247	51,845	4,945	1,714	39	
Total	109,081	51,528	214,837	179,551	554,997	597,787	259,294	8,129	1,049,467
Total, 1919	84,658	42,943	194,838	172,789	495,228	138,649	251,856	5,264	1,794,784
Difference	+24,423	+8,585	+19,999	+6,762	+59,769	+459,138	+7,438	+2,865	—745,317

Province.	Tanbark.	Wood-oils.	Copal (Almáciga).	Daluru.	Gutta-percha.	Split rattan.	Unsplit rattan.		Diliman.
							Over 2 cm. in diameters.	2 cm. in diameters or less.	
	Kilos.	*Liters.*	*Kilos.*	*Cu. m.*	*Kilos.*	*Kilos.*	*Lin. m.*	*Lin. m.*	*Kilos.*
Abra							172,464	18,000	
Agusan						38,990	1,200		1,330
Albay	9,089					8 89,370	26,000		
Antique						6,010	280		1,870
Bataan	622					80,058	557,907	65,000	2,953
Batangas	81,766		414			332			
Bohol	3,735					407			174
Bukidnon						394			
Bulacan	3,800					6,428	480,078	153,680	
Cagayan		100				116,978	390,143	17,194	
Camarines Norte	7,341					212,244			240
Camarines Sur	176,727		342,277			288,504	231,669		616
Capiz				8		2,064			
Cavite	12,567								
Cebu	1,904					1,257			150
Cotabato	4,164				348,636	1,306			
Davao	100	286	595,621			1,393	182,418		

Ilocos Norte	6,040					4,006	1,600		
Ilocos Sur									
Iloilo	172,294		175			4,564			510
Isabela							92,273	4,000	
Laguna	16,213					26,439	21,480		15,613
Lanao					340	1,257	7,000		1,597
La Union									
Leyte	184	18,840				104,941	54,915	2,075	19,698
Marinduque						541			8,897
Mindoro	81,102					64,398	11,640		28,467
Misamis	20		6,623			4,951			1,988
Mountain Province						8,732	6,000		
Negros Occidental		10,857				21,572	21,800		1,151
Negros Oriental		11,995				120,899	9,800		1,060
Nueva Ecija	8,299						326,240	50,165	
Nueva Vizcaya							7,200	200	
Palawan	68,629		140,154			8,514	471,447		
Pampanga				247		3,067	2,600		600
Pangasinan	82,710						64,700		
Rizal	5,704					46,275	9,675		1,267
Romblon		200	6,928			1,589			
Samar	180,831	812				218,253	79,077		5,270
Sorsogon	19,430	9,365	4,935			19,498			12,890
Sulu	8,000		150			660			
Surigao	28,787	375				167,896	26,835		
Tarlac	10,573		764			9,907	3,100	77,250	
Tayabas	81,428		732,354			441,602	912,603	1,884,990	4,172
Zambales	11,020			8		11,867	120,650	998,038	
Zamboanga	234,601		11,001		7,592	27,867	97,820		
Total	1,157,575	52,830	1,841,896	263	356,568	2,153,025	4,389,114	2,716,587	109,963
Total, 1919	1,780,705	109,536	1,092,828	283	20,693	3,059,936	2,550,229	15,248,237	120,700
Difference	—623,130	—56,706	+748,573	—20	+335,875	—906,911	+1,838,885	—12,531,650	—10,737

NOTE: + = increases; — = decreases.

TABLE NO. 6–A.—*Report of utilization of forest products from public forest of the Philippine Islands during the fiscal year 1920 (January 1 to December 31)*—Continued.

Province.	Lime-stone.	Gogo.	Stone and sand.	Buri.	Guano.	Earth.	Nipa.	Dyebark.	Cabo negro.
	Kilos.	*Kilos.*	*Kilos.*	*Kilos.*	*Kilos.*	*Cu. m.*	*Shingles.*	*Kilos.*	*Kilos.*
Abra	6,000								
Agusan									
Albay			3						
Antique									
Bataan		1,080							
Batangas	207,250	32,605		5,662				1,500	
Bohol		291		180				4	
Bukidnon									
Bulacan		50							
Cagayan		250							
Camarines Norte	10,500		700						
Camarines Sur								80	
Capiz				19,280				1,426	
Cavite		33,907							
Cebu				80,282				265	
Cotabato									
Davao									
Ilocos Norte								2,808	
Ilocos Sur	74,795		49,278						
Iloilo		218			5				
Isabela									
Laguna		159				1,800			
Lanao							11,800		
La Union									
Leyte			810					223	
Marinduque								605	
Mindoro		903		18,786				11,016	
Misamis								740	
Mountain Province	160,100		810			11			
Negros Occidental		726							120
Negros Oriental		9,845						1,736	
Nueva Ecija		5,184		470,020				100	
Nueva Vizcaya									
Palawan		28,159						29,936	
Pampanga		790		61,954					
Pangasinan		680		8,948					
Rizal		745		27,184				1,277	
Romblon									
Samar								155	
Sorsogon		4,915		5,384				19,565	
Sulu									

Surigao			212						
Tarlac		1,654		18,885					
Tayabas		96		274,974	211			5,311	
Zambales		9,541							
Zamboanga									
Total	458,645	126,198	51,813	985,889	216	1,811	11,800	75,747	120
Total, 1919	288,112	130,127	118,290	39,946				64,866	
Difference	+170,533	—3,929	—66,477	+945,943				+10,881	

NOTE: + = increases; — = decreases.

TABLE NO. 6–B.—*Statement of forest products, cut or gathered from registered private woodlands during fiscal year 1920.*

Province.	Timber.					Firewood.		Char-coal.	Tan-bark.	Gogo.	Dye-bark.	Split rattan.	Rattan over 2 centimeters in diameter.	White earth Balls.	Daluru.
	First group.	Second group.	Third group.	Fourth group.	Total.	First class.	Second class.								
	Cu. m.	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Kilos.*	*Kilos.*	*Kilos.*	*Kilos.*	*Linear meters.*		*Cu. m.*
Albay		52	155	49	256		25								
Bataan		1	112	6	119		544	1							
Batangas				14	14	4,250	1,825		3						
Bulacan	7				7	2,743	301								
Capiz						1,051	228								
Cavite							1,877	40		507					
Ilocos Norte	25	36	2	58	121										
Iloilo						28	878	66							
Laguna						83	17,058	2,053	3,950				16,000	11,300	
Mindoro	14	52	22	29	117										
Negros Occidental	14	84	781	1,005	1,884		2,028								
Negros Oriental	37				37										
Nueva Ecija	28	4		12	39		338	1		1,860		9,057			
Palawan											4,375				
Pampanga				22	22	9,525	7,785	2,664							57
Rizal	68	4	5	24	101		14,197	85	6,976		711	120			
Tarlac	144	4	6	11	165		5,042	365				750	12,100		
Tayabas	10				10										
Total	842	237	1,088	1,280	2,892	17,680	52,066	5,225	10,929	2,367	5,086	9,927	28,100	11,300	57

TABLE NO. 7.—*Minor products licenses in force during fiscal year 1920 (January 1, to December 31).*

Province.	Firewood.	Charcoal.	Dyewood.	Tanbarks and dyebark.	Wood oils.	Almaciga, resins and others.	Gutta-percha.	Bejuco and diliman.	Gogo.	Sand gravel and stone.	Others.	Total.
Abra	16							13				29
Agusan	6	1				1		46			2	56
Albay	42			2		2		51				97
Antique	2			1		1		22				26
Bataan	80	14			1	4		69	12			180
Batangas	11			6						4		21
Bohol	17											17
Bukidnon	1					1		13				15
Bulacan	5	12		1				35	1			54
Cagayan	29			3	1	6		104				143
Camarines Norte	81	1		2	1	11		88	1	3		188
Camarines Sur	39	1		3		18		98		5		164
Capiz	47	4		3				8			2	64
Cavite	8	1		2					10			21
Cebu	40	1									7	48
Cotabato	14			3	6	10	11	8			12	64
Davao	34	4			9	10	1	18		1	3	80
Ilocos Norte	14			1				6		3		24
Ilocos Sur	6	1		2				1		21		31
Iloilo	79	10	23	10	2			10			7	141
Isabela	13					4		29				46
Laguna	11	5		3		4		27	3		12	65
Lanao	7			1		3	2	10			7	30
La Union	1			1								2
Leyte	45	2		1	5			48		8		109
Marinduque	9			3		4		8	1			25
Mindoro	43			20		4		83	22		5	177
Misamis	14			1	1	3	2	20			2	43
Mountain Province	30			2		1		36		13		82
Nueva Ecija	13	3		2				48	23		18	107
Nueva Vizcaya	5					1		18				24
Occidental Negros	59				24	2		161	20	1	11	278
Oriental Negros	12					6		50	9			77
Palawan	55		1	30	3	18		47	10		7	171
Pampanga	12	7						9	3		4	35
Pangasinan	42	4	3	18				5	5		3	80
Rizal	37	10		4				18	9		1	79
Romblon	4				5	8		4			8	29
Samar	38			4	5	1		76				124
Sorsogon	58			11	5	7		76	3		4	164
Sulu	2	1										3
Surigao	25	4		6	1			28		2	1	67
Tarlac	12	3		2		3		15	9		4	48

TABLE No. 7.—*Minor products licences in force during fiscal year 1920 (January 1, to December 31)*—Continued.

Province.	Firewood.	Charcoal.	Dyewood.	Tanbarks and dyebark.	Wood oils.	Almaciga, resins and others.	Gutta-percha.	Bejuco and diliman.	Gogo.	Sandgravel and stone.	Others.	Total.
Tayabas	87	7	....	19	....	90	....	142	16	3	27	391
Zambales	47	7	....	9	1	7	....	42	8	....	9	130
Zamboanga	42	5	....	12	2	18	17	61	....	....	5	162
Total	1,194	108	27	188	72	248	33	1,646	165	64	166	3,911
Total, 1919	1,665	175	44	336	71	263	28	2,055	291	....	255	5,179
Difference	—471	—67	—17	—148	+1	—15	+5	—409	—126	....	—89	—1,268

NOTE: + = increases; — = decreases.

TABLE No. 8.—*Statement showing the quantity and value of minor forest products exported during the fiscal year 1920 (January 1 to December 31).*

	Kilos.	Value.
Copal (almáciga):		
United States	454,308	₱177,716
United Kingdom	243,889	76,103
Belgium	3,325	1,304
France	83,230	28,790
Spain	6,900	2,400
British East Indies	203,126	73,035
Japan	18,548	6,591
Australasia	6,508	1,725
Total	1,019,834	367,664
Elemi (pili resin):		
United States	244,507	233,070
United Kingdom	41,021	42,367
Belgium	11,817	10,514
France	16,717	10,895
Germany	4,541	2,842
Spain	4,500	3,400
British East Indies	465	1,940
Hongkong	4,560	6,000
Total	328,308	311,028
Gutta-percha:		
United States	170	2,000
British East Indies	77,914	99,388
Total	78,084	101,388
Rubber:		
United States	57,232	85,300
Spain	860	2,000
British East Indies	1,872	2,250
Total	59,964	89,550
Lumbang (candle nut) oil:		
United States	156,308	114,072
United Kingdom	755	906
Spain	1,411	1,349
Total	158,474	116,327
Sappan wood (sibukau):		
China	219,604	14,276
Hongkong	711,845	27,371
Total	931,449	41,647
Total	....	1,027,599

TABLE NO. 9.—*Statement of appropriation and expenditures, Bureau of Forestry (January 1 to December 31, 1920).*

Appropriation:		
Act No. 2875		₱565,000.00
Expenditures:		
Salaries and wages	₱326,177.17	
Bonus	61,616.38	
Furniture and equipment	19,968.29	
Traveling expenses of personnel	62,488.82	
Rentals of buildings and grounds	8,799.47	
Freight, express and delivery service	2,857.68	
Printing and binding reports, documents and publications	5,000.00	
Postal, telegraph and cable service	8,193.57	
Illumination and power service	4,151.07	
Plant and equipment repair service	1,802.49	
Contingent service	2,876.28	
Consumption of supplies and materials	37,207.81	
Traveling expense of persons not Government employees	350.00	
Total expenditures		541,488.53
Balance January 1, 1921		23,511.47
Appropriation for construction of a fire-proof vault (Act No. 1786):		
Balance January 1, 1920		2,307,17
Expenditures		290.31
Balance January 1, 1921		2,016.88
Appropriation for construction of three forest stations (Act No. 2786)		5,000.00
Expenditures		4,961.71
Balance January 1, 1921		38.29
Appropriation for installation of an electric lighting system, Los Baños (Act No. 2876)		6,000.00
Expenditures		5,957.83
Balance January 1, 1921		42.17
Appropriation for purchase and installation of a still for water, Los Baños (Act No. 2898)		4,000.00
Expenditures		2,524.89
Balance January 1, 1921		1,475.11
Statement of Bureau of Forestry appropriations, expenditures and revenues for fiscal year 1920:		
Appropriation		565,000.00
Revenue		1,009,879.13
Expenditures		541,488.53
Surplus		468,390.60
Percentage of expenditures to revenue		.54

DIRECTORY OF THE BUREAU OF FORESTRY

ARTHUR F. FISCHER, *Director.*

DIVISION OF FOREST MANAGEMENT.

Fred L. Pray	Forester, Chief.
Ramon J. Alvarez	Forester, Assistant chief.
Florencio Tamesis [1]	Assistant Forester.
Porfirio San Buenaventura	Forest supervisor.
Agapito L. Cenabre	Forest supervisor.
Felix Franco [1]	Forest supervisor.
Eladio C. Leaño	Forest supervisor.
Nazario Peñas [1]	Forest supervisor.
Apolinario Suyat [1]	Forest supervisor.
Carlos Guerrero	Ranger.
Miguel Pajarillo	Junior stenographer.

LICENSE SECTION.

Juan Lopez	Forest supervisor, In charge.
Petronilo Cortes	Ranger.
Leonardo Laguio	Ranger.
Eufemio Santillan	In charge of clerks.
Agustin Baula	Clerk (Ty.)
Enrique Baña	Clerk.
Fausto Pe Benito	Clerk.
Melanio Espiritu	Clerk.
Arcadio Gepiga	Clerk.
Luis S. Mabagos	Clerk.
Avelino Rivera	Clerk
Tomasa Buensuceso (Miss)	Junior stenographer.

WOOD EXPERT SECTION.

Edwin E. Schneider	Wood expert, Chief.
Luis J. Reyes [1]	Ranger, Assistant chief.
Justo M. Pascual	Ranger.
Alberto Barros	Ranger.
Luis Adona	Ranger.
Aurelio Maglunog	Clerk.
Andres G. Ferrer	Clerk.

DISTRICT No. 1.

[Provinces: Cagayan, Isabela and Mountain Province (Apayao) and Kalinga.]

Forest Station at Aparri, Cagayan (district headquarters):

Pastor de la Peña	Officer in charge.
Francisco Siriban	Ranger.

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[1] Government pensionados studying in the United States.

Forest Station at Aparri, Cagayan (district headquarters)—Continued.

Felipe T. Pattagulan	Clerk.
Ambrosio Bitonio	Forest guard.

Forest Station at Ilagan, Isabela:

Mamerto Azurin	Officer in charge.

Forest Station at Tuguegarao, Cagayan:

Deogracias Guzman	Officer in charge.

Forest Station at Echague, Isabela:

Vicente Velasco	Officer in charge.

Forest Station at Claveria, Cagayan:

Luis Aguilar	Officer in charge.

DISTRICT No. 2.

[Privinces: Ilocos Norte, Ilocos Sur, and Abra.]

Forest Station at Vigan, Ilocos Sur (district headquarters):

Espiritu Paraiso	Officer in charge.
Ambrosio Damo	Ranger
Ponciano Pacada	Forest guard.
Zoilo Sambrano	Forest guard.

Forest Station at Bangued, Abra:

Cayetano Barros	Officer in charge.
Juan Balbuena	Forest guard.

DISTRICT No. 3.

[Provinces: Mountain Provinces, Benguet, Bontoc, and Amburayan.]

Forest Station at Baguio, Benguet (district headquarters):

Mauricio J. Oteyza	District forester.
Vicente J. Defensor	Ranger.
Edilberto Madrid	Ranger.
Jose Medina	Ranger.
Francisco Bagaui	Forest guard.
Aquilino Balbin	Forest guard.
Luis Chigas	Forest guard.
Esteban Fontanilla	Forest guard.
Silverio Gapuz	Forest guard.
Pedro Gacad	Forest guard.
Pastor Gracia	Forest guard.
Timoteo Lagasca	Forest guard.
Miguel Mangabat	Forest guard.
Valentin Ulep	Forest guard.

DISTRICT No. 4.

[Provinces: Pangasinan, Nueva Ecija, Nueva Vizcaya, Tarlac, and Northern Zambales.]

Forest Station at Dagupan, Pangasinan (district headquarters):

Benigno Alejandro	Officer in charge.
Juan Acenas	Ranger.
Marcial Agayan	Forest guard.
Canuto Ducusin	Forest guard.
Gregorio Valenzuela	Forest guard.
Irineo Lopez	Clerk.

Forest Station at Cuyapo, Nueva Ecija:

Manuel Montalvo	Officer in charge.
Amando Curaming	Ranger.
Anselmo Agustin	Forest guard.
Victorino Mariano	Forest guard.

Forest Station at Bayombong, Nueva Vizcaya:	
Pedro Afalla	Officer in charge.
Protacio Taboy	Forest guard.
Gerardo S. Marańa	Forest guard.

DISTRICT No. 5.

[Provinces: Batangas, Laguna, Tayabas, and Marinduque.]

Forest Station at Los Baños, Laguna (district headquarters):	
Lyman H. Taft, Jr.	District forester.
Pedro P. Lasquety	Ranger.
Pioquinto de la Vega	Ranger.
Justino Mahupil	Clerk.
Cirilo Cabauatan	Forest guard.
Ildefonso C. Ferrer	Forest guard.
Lorenzo Onofre	Forest guard.
Pedro Redondo	Forest guard.
Forest Station at Calauag, Tayabas:	
Braulio Cristobal	Officer in charge.
Gregorio Arizabal	Ranger.
Albino Labaco	Forest guard.
Castor Jundak	Forest guard.
Forest Station at Infanta, Tayabas:	
Mauro S. Baculi	Officer in charge.
Gregorio Mopera	Forest guard.
Forest Station at Laguimanoc, Tayabas:	
Julio Baldemor	Officer in charge.
Felix Dayao	Forest guard.
Victor Gaboco	Forest guard.
Eusebio Villanueva	Forest guard.
Forest Station at Kabibihan, Tayabas:	
Pedro C. Pujalte	Officer in charge.
Cayetano Gamalinda	Forest guard.
Forest Station at Lucban, Tayabas:	
Norberto Soloria	Officer in charge.
Angel S. Sarmiento	Forest guard.

DISTRICT No. 6.

[Provinces: Albay, Camarines Norte, Camarines Sur, and Sorsogon.]

Forest Station at Naga, Camarines Sur (district headquarters):	
Macario A. Mariano	Officer in charge.
Gregorio J. Labitag	Ranger.
Inocencio Ramirez	Ranger.
Fermin Sol	Forest guard.
Catalino Clemente	Clerk.
Forest Station at Paracale, Camarines Norte:	
Jesus O. Duran	Officer in charge.
Eulogio Gines	Forest guard.
Felix Andrade	Forest guard.
Pedro Magistrado	Forest guard.
Forest Station at Sorsogon, Sorsogon:	
Numeriano Valencia	Officer in charge.
Alejandro Eguarras	Forest guard.
Melecio Lagunoy	Forest guard.

Forest Station at Catabañgan, Ragay, Camarines Sur:

Macario Simeon	Officer in charge.
Pedro Silvestre	Forest guard.
Vedasto Rafa	Forest guard.

Forest Station at Virac, Albay:

Felix Mabbayag	Officer in charge.
Mariano Tacorda	Forest guard.

Forest Station at Legaspi, Albay:

Filemon Kapuno	Officer in charge.
Vicente Encernereal	Forest guard.
Agapito Borja	Forest guard.

DISTRICT No. 7.

[Provinces: Antique, Capiz, Iloilo, Negros Occidental, and Romblon.]

Forest Station at Iloilo, Iloilo (district headquarters):

Jose B. Hirro	Officer in charge.
Jose B. Logan	Ranger.
Maximino Rondario	Ranger.
Pedro Valentin	Ranger.
Gabino Jarantilla	Forest guard.

Forest Station at Cadiz, Negros Occidental:

Bernardo Tocmo	Officer in charge.
Roman Amor	Ranger.
Ramon Javellana	Forest gurad.
Teodoro Oliveros	Forest guard.
Mansueto Olaira	Forest guard.
Fermin Quijano	Forest guard.
Leon de los Reyes	Forest guard.

Forest Station at Ilog, Negros Occidental:

Ramon Larracas	Officer in charge.
Vicente Villaflor	Ranger.
Inocencio Debuyan	Forest guard.
Pablo Panaguiton	Forest guard.
Magdaleno Pagonzaga	Forest guard.

Forest Station at Fabrica, Negros Occidental:

Juan S. Versoza	Officer in charge.
Gorgonio Canto	Forest guard.
Francisco Diaz	Forest guard.
Severino E. Lovero	Forest guard.
Ruperto Yzarri	Forest guard.

Forest Station at San Carlos, Negros Occidental:

Melecio Lopez	Officer in charge.
Fausto Ejercito	Forest guard.
Tiburcio Guanzon	Forest guard.

Forest Station at New Washington, Capiz:

Probo Villanueva	Officer in charge.
Hermenegildo Barabona	Forest guard.
Epifañio Biñas	Forest guard.
Flaviano Ocaban	Forest guard.

DISTRICT No. 8.

[Provinces: Zamboanga, Cotabato, Davao, Sulu, Misamis, Lanao, and Bukidnon.]

Forest Station at Zamboanga, Zamboanga (district headquarters):

James Logan	District forester.
Florencio Asiddao	Ranger.

Forest Station at Zamboanga, Zamboanga (district headquarters)—Cont.

Lonrenzo Logan	Ranger.
Pedro Aguilar	Forest guard.
Matias Arivan	Clerk.

Forest Station at Dipolog, Zamboanga:

Manuel Malana	Officer in charge.
Tomas Cuartero	Forest guard.
Antonio Dancalan	Forest guard.
Estanislao Buin	Forest guard.

Forest Station at Cotabato, Cotabato:

Nicanor E. Santos	Officer in charge.
Sixto Babao	Ranger.
Jose C. Nolasco	Forest guard.

Forest Station at Isabela Basilan:

Teodoro Tecson	Officer in charge.
Tajun (Moro)	Forest guard.
Isabela Ostrea	Forest guard.

Forest Station at Jolo, Sulu:

Juan Corales	Officer in charge.

Forest Station at Kolambugan, Lanao:

Severo Oliveros	Officer in charge.
Timoteo Quimpo	Ranger.
Pedro Carro	Forest guard.
Guillermo Luñgay	Forest guard.

Forest Station at Naga-Naga, Zamboanga:

Enrique Alviar	Officer in charge.
Santiago Babaran	Ranger.
Juan Daproza	Ranger.
Bonifacio Perez	Ranger.
Benito F. Antonio	Forest guard.
Bituanon (Moro)	Forest guard.
Manuel San Luis	Forest guard.

Forest Station at Port Banga, Zamboanga:

Jose Flores	Officer in charge.

Forest Station at Mati, Davao:

Juan C. Andrada	Officer in charge.

Forest Station at Davao, Davao:

Simplicio Aguilar	Officer in charge.
Gregorio Elumir	Ranger.
Ramon Mataya	Ranger.
Antonio Fernando	Forest guard.

Forest Station at Cagayan, Misamis:

Gregorio Miras	Officer in charge.

DISTRICT No. 9.

[Province: Palawan.]

Forest Station at Puerto Princesa, Palawan (district headquarters):

Ptolomeo Causing	Officer in charge.
Miguel Pato	Ranger.
Benito L. Roque	Ranger.

Forest Station at Coron, Palawan:

Mauro Ablaza	Officer in charge.
Alejandro Palao	Forest guard.

DISTRICT No. 10.

[Provinces: Leyte, Surigao, Samar, and Masbate.]

Forest Station at Tacloban, Leyte (district headquarters):

Adriano V. Santos	Officer in charge.
Agustin P. Angeles	Ranger.
Jose G. Pacis	Ranger.
Leon Rojas	Ranger.
Florentino C. Versoza	Ranger.
Marcelo Mercado	Forest guard.
Florentino L. Nerviol	Forest guard.
Margarito Rosales	Forest guard.
Jose Sydiongco	Forest guard.
Pablo de la Cruz	Clerk.

Forest Station at Catbalogan, Samar:

Ramon Acuña	Officer in charge.
Potenciano Lucero	Forest guard.

Forest Station at Laoang, Samar:

Emeterio Edmilao	Officer in charge.
Sergio Giray	Forest guard.

Forest Station at Masbate, Masbate:

Atanasio B. Catambay	Officer in charge.
Lino Bajar	Forest guard.
Felix Perez	Forest guard.

Forest Station at Surigao, Surigao:

Perfecto Tomeldan	Officer in charge.

DISTRICT No. 11.

[Provinces: Bataan, Rizal, Cavite, Pampanga, Bulacan, and Southern Zambales.]

Forest Station at Manila (district headquarters):

Clemente Mariano	Officer in charge.
Ambrosio Galisim	Ranger.
Pio Ilusorio	Forest guard.
Eugenio Mendoza	Clerk.

Forest Station at Arayat, Pampanga:

Hilario Borromeo	Officer in charge.
Hospicio Guevarra	Forest guard.

Forest Station at Orani, Bataan:

Pedro Gangan	Officer in charge.
Victorio Alquiroz	Forest guard.
Arcadio Nava	Forest guard.

Forest Station at Limay, Bataan:

Tomas N. Roque	Officer in charge.
Florencio M. Songco	Ranger.
Deogracias Agustin	Forest guard.
Primitivo Baluyot	Forest guard.
Valentin Hizon	Forest guard.
Dionicio Mananghaya	Forest guard.
Teodoro Magalindan	Forest guard.

Forest Station at Moron, Bataan:

Fernando L. Amarillas	Officer in charge.
Raymundo Santos	Forest guard.

Forest Station at Norzagaray, Bulacan:

Andres Bernardo	Officer in charge.
Marcelino Catapusan	Forest guard.

Forest Station at Masinloc, Zambales:

Valentin Sajor	Officer in charge.
Valeriano V. Elgincolin	Forest guard.

DISTRICT No. 12.

[Province: Mindoro.]

Forest Station at Calapan, Mindoro (district headquarters):

Cornelio Nable Jose	Officer in charge.
Eusebio Leuterio	Ranger.
Aniano David	Ranger.
Cornelio Acedillo	Forest guard.

Forest Station at San Jose, Mindoro:

Manuel Tupas	Officer in charge.
Leoncio Rebong	Ranger.
Fulgencio E. Pandiño	Forest guard.

DISTRICT No. 13.

[Provinces: Cebu, Negros Oriental, and Agusan.]

Forest Station at Cebu (district headquarters):

Isabelo Achacoso	Officer in charge.
Leonor Lizardo	Ranger.
Silvino Reyes	Ranger.
Vicente Zosa	Ranger.
Victoriano Caratao	Forest guard.
Rufino A. del Mar	Forest guard.
Juan Dosado	Clerk.

Forest Station at Dumaguete, Negros Oriental:

Alberto Villanueva	Officer in charge.
Venancio S. Fernandez	Forest guard.

Forest Station at Butuan, Agusan:

Angel Mallonga	Officer in charge.
Rufo Burnea	Forest guard.
Norbreto D. Conde	Forest guard.

DIVISION OF FOREST LANDS AND MAPS.

Rafael Medina	Forester, Chief.
Doroteo Soriano	Forest Supervisor, Assistant to the chief.
Marcelino Quimpo	Clerk.

FOREST LANDS SECTION.

Cecilio Maneja	Forest Supervisor, Chief.
Fausto Alambra	Ranger.
Eugenio de la Cruz	Ranger.
Alejandro de Mesa	Ranger.
Crispino Tansioco	Ranger.
Eligio Cordero	Clerk.
Conrado Tongco	Clerk.

RECONNAISSANCE SECTION.

Severo S. Ponce	Forest Supervisor, Chief.
Pedro Aduviso	Ranger.
Vicente Castillo	Ranger.
Aquilino Contreras	Ranger.

Leoncio A. de la Cruz	Ranger.
Vicente Caguioa	Ranger.
Juan Fontanoza	Ranger.
Quintin Gellidon	Ranger.
Pedro Montero	Ranger.
Celso Medrano	Ranger.
Juan Oblina	Ranger.
Vicente Parras	Ranger.
Gervasio Rarang	Ranger.
Angel Salazar	Ranger.
Rafael San Pedro	Ranger.
Edilberto Barot	Clerk.
Bernardino A. Valderrama	Clerk.

MAP SECTION.

Cornelio Samaniego	Draftsman, Chief.
Cayetano Crisostomo	Draftsman.
Cecilio de la Cruz	Draftsman.
Marcelino Cruz	Draftsman.
Sebastian Domingo	Draftsman.
Moises de Guzman	Draftsman.
Wenceslao Moje	Draftsman.
Angel Reyes	Draftsman.
Hermogenes Reyes	Draftsman.
Gregorio Vicencio	Draftsman.

DIVISION OF INVESTIGATION, LOS BAÑOS, LAGUNA.

William H. Brown	Technical employee, Chief.
Theodore C. Zschokke	Forester.
Antonio P. Racelis	Forester.
Otto W. Pflueger	Forester.
Frank Cofren	Proof reader
Jose F. Nano	Ranger.
Maximo Oro	Ranger.
Francisco L. Rola	Ranger.
Carlos Sulit	Ranger.
Felipe Salvoza	Ranger.
Felix Columbres	Forest guard.
Esteban Mojado	Forest guard.
Nicolas Angeles	Nurseryman.
Florentino Canicosa	Nurseryman.
Domingo Ilag	Nurseryman.
Maximo Pañga	Nurseryman.
Julian Rebelleza	Nurseryman.

DIVISION OF SAWMILLS AND UTILIZATION.[1]

William Crosby	Forester, Chief.
Donato P. Miranda	Forest supervisor.
Sinforoso Apacible	Forest guard.
Pablo Roque	Forest guard.
Doroteo Abella	Clerk.

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[1] All scalers under Division of Forest Management are also under this division.

ADMINISTRATIVE DIVISION.

Vicente C. Ramos	Chief clerk.
Eugenio Tadle	Cashier and Disbursing officer.
Jovito Unite	Senior stenographer.
Aurea Villaruz (Miss)	Junior stenographer.
Agustin Cardines	Clerk.
Mauro Linchanco	Messenger.
Gabino Cubos	Chauffeur.
Ignacio Cebrano	Janitor.
Pastor Ramos	Janitor.
Macario Rivera	Janitor.

RECORDS SECTION.

Aquilino C. Bartolome	Chief.
Jacinto Barlis	Clerk.
Juanita Canlas (Miss)	Clerk.
Jose Caluag	Clerk.
Laureano Navasca	Clerk.
Carlos Ubuñgen	Clerk.
Jose Salvador	Clerk.
Francisco Balderosa	Messenger.
Balbino B. Nanong	Messenger.

DIVISION OF ACCOUNTS AND PROPERTY.

Cirilo Asperilla	Chief.
Sulpicio Olimpo	Clerk.

AUDITS SECTION.

Melchor Enriquez	Clerk.
Juan Acojido	Clerk.
Deogracias Antonio	Clerk.
Aguedo Castro	Clerk.
Demetrio Saluñga	Clerk.
Jose Santos	Clerk.
Francisco O. Santos	Clerk.

PROPERTY SECTION.

Pablo D. Villena	Chief.
Venancio Babida	Clerk.
Vicente Gatan	Clerk.
Santiago Laya	Clerk.
Victorino Narcelles	Clerk.
Irineo Carlos	Janitor.
Bartolome Estacio	Janitor.
Severino Esguerra	Watchman.
Epitacio Oblepias	Watchman.

LIBRARY AND STATISTICAL SECTION.

Simplicio Beltran	Chief.

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF FORESTRY

Annual Report of the Director of Forestry of the Philippine Islands

For the Fiscal Year Ended December 31, 1921

ARTHUR F. FISCHER
Director of Forestry

MANILA
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ANNUAL REPORT OF THE DIRECTOR OF FORESTRY

MANILA, *February 2, 1922.*

SIR: I have the honor to submit the Annual Report of the Bureau of Forestry for the fiscal year ending December 31, 1921. The undersigned returned from leave in the United States on March 4, 1921, after an absence of nearly a year. He wishes to take this occasion of acknowledging the loyalty and effort put forth by the entire personnel of the Bureau of Forestry under trying conditions during his absence.

LEGISLATION

During the year no bills were passed affecting the Bureau of Forestry, but one bill was introduced—House Bill No. 962, providing that ten per cent of the forest charges be given the municipality from which the forest products were taken. This bill failed of passage.

A considerable number of changes in the laws affecting the Bureau of Forestry were proposed through the Office of the Secretary of Agriculture and Natural Resources and later on these changes were submitted to the Finance Commission at their request, in order for them to study the proposed changes in relation to their plan of reorganization.

PERSONNEL

The acute condition in regard to personnel has again prevailed this past year, but due to the financial depression and consequent business depression, many of the licensees either curtailed their business or closed up entirely, which eased the situation to some extent during this year. This allowed us to carry on, at least in part, the work of land classification which had not been carried out as per schedule and needs of the Government. Another fact augmenting the personnel question considerably was the revision allowed by the Governor-General and the Civil Service during 1920, by placing rangers in a special classification and raising the maximum salary to ₱2,400, but the appropriation allowed by the Government did not permit the carrying out of this change. During 1920, considerable resignations took place because of dissatisfaction on this account, but the general business conditions developed a disposition on the part of some of these men for reinstatement into their former positions. This could not be allowed because of the action of the Emergency Board in cutting down appropriations to such a point that the Bureau was unable to fill these positions and even if these positions were available, the necessary allotment for travel, equipment, etc., was not available. This brought about a tremendous increase of work to be carried by the remaining personnel of this Bureau and necessitated the refusal of requests for leave. This again did not aid to the morale.

Should indications of the revival of the lumber industry materialize, the amount of work to be carried by the personnel of this Bureau during the coming year, without adequate recognition on the part of the Government in the increase of salaries, already allowed by the Civil Service and the Governor-General's Office, in the ranger classification, there is no doubt that instead of alleviating the personnel situation of this Bureau, it will be augmented. During the past year, 21 resignations took place. They are classed as follows: Two foresters, one wood expert (retired), seven rangers, ten clerks, and one draftsman.

After reduction of personnel due to resignation or economy, the classified force on December 31, 1921, consisted of: One Director, 9 foresters, 1 assistant forester (in the United States as pensionado), 11 forest supervisors (9 in active service, 2 in the United States as pensionados), 134 rangers, 6 draftsmen, 42 clerks, and 2 messengers, making a total of 206. The temporary employees were: Two technical employees (1 without compensation), 1 proof-reader, 2 laboratory helpers, 66 forest guards, 10 clerks, 5 draftsmen, 5 nurserymen, 6 carpenters, 2 varnishers, 1 chauffeur, 1 messenger, 2 watchmen, 5 janitors, 3 laborers, and 1 porter, making a total of 112. The entire force on December 31, 1921, was therefore 318.

DIVISION OF FOREST MANAGEMENT

The main work of this Division consists in formulating and carrying out under the direction of the Director, rules and plans for the proper protection and exploitation of the forest, having in view the improvement of the composition and density of the stand and to carry out the work so that in the future we may always have a supply of valuable forest products for the market.

The force of this Division at the end of the year consists of the following field and office force: Four foresters, one assistant forester, six forest supervisors, eighty-three rangers, forty-four forest guards, one junior stenographer, and fourteen clerks.

The present force of this Division is not sufficient to handle the full volume of pending work although the amount of work accomplished in proportion to the number of personnel is very gratifying.

To securé a proper supervision of license areas, caiñgin patrol, special use permits and illegal cutting operations, an increase in the present force of at least 20 per cent is necessary.

INSPECTION

The following table shows the forest stations throughout the thirteen districts inspected during the year 1921 by the supervising personnel of the Bureau:

District No.	Station.	Inspected by—	Date, 1921.	Report submitted.
1	Echague	A. Suyat	September 6	1
	Ilagan	do	July 10–19	
	Alcala	do	May 11	
	Aparri	do	April 6	
	Claveria	do	April 10–25	
	Dagupan	do	October 27	
4	Bayombong	A. L. Cenabre	July 11	Sawmill.
5	Kabibihan	do	November 15	One sawmill.
	Calauag	Director	December 23	
6	Catabangan	A. L. Cenabre	November 29	1
	Naga	do	November 8	1
	Légaspi	do	September 27	1
	Sorsogon	do	October 19	1
	Virac	do	October 3–5	1
	Mercedes	do	September 6	1
8	Zamboanga	J. Lopez	April	1
	Cotabato	do	April	
	Jolo	do	April	
	Cagayan	do	April	
	Davao	P. S. Buenaventura		
18	Cebu	J. Lopez	April	
	Butuan	do	April	1

As can be seen from the foregoing table, there was less inspections made this year than in 1920. The district foresters and officers in charge of the districts, however, practically inspected all the forest stations under their respective jurisdiction.

LICENSES

License Statistics.—During the year 1921, there was a decrease of 184 in the number of ordinary timber licenses issued as compared with 1920, a total of 2,309 being issued during the year. This decrease was due principally to the decreasing demand for lumber resulting from the acute commercial depression prevailing throughout the world, and partly to the policy of this office to curtail as much as possible the tendency of many persons to control timbered areas for speculative purposes without any intention of personally operating them and investing capital in the operations, and to the requirement imposed by this Bureau to every applicant to deposit cash bonds in accordance with Department Order No. 10 of the Honorable, the Secretary of Agriculture and Natural Resources, series 1920.

On the other hand, a little improvement was noted in the minor forest product business. This is shown by the fact that of licenses for such products, a total of 4,635 were issued, showing an increase of 724 over those of the previous year. This increase was attributed primarily to the increasing demand for tanbark, dyebark, wood oils, diliman, gogo, and guano, and partly to the reaction on rattan industry.

In regard to gratuitous licenses there was a slight increase, 2,692 being issued in 1920, whereas this year there were 2,799, an increase of 107. In addition to these there were 378 licenses issued this year for building tobacco curing houses.

Tables showing in detail the licenses issued and the amount of forest products utilized during the year, and a comparison of the totals of each with those of the previous year, will be found in the appendix.

OFFENSES OF LICENSEES

There was a marked decrease in the offenses of licensees in 1921, due to the more careful inspection of license areas, the increased efficiency in patrol work by forest guards, and careful operations of licensees to observe the rules and regulations of this Bureau.

The most noticeable violations which came to the attention of this Office is the cutting of undersize first group trees for ties and those by licensees who merely secure a license and then collect a royalty from people who want to cut timber and firewood and other forest products. The licenses of such persistent offenders are promptly cancelled.

OFFENSES OF NON-LICENSEES

There has been a marked decrease during 1921, in the number of complaints received of illegal cutting by non-licensees. It is attributed to the increased efficiency of the patrol work and inspection of barrios and sitios by the forest guards.

COÖPERATION AND PROPAGANDA

The wide spread of propaganda of forest conservation and forest protection resulting from wise management of the forest begun by the Bureau in the past years has not been successful in 1921. The district men under this Division gave informal talks in barrios and in public schools when opportunities presented themselves and explained conservation, forest protection, and the evil of forest destruction by caiñgin and cogon fires to the people; but due to the general depression, and low price of agricultural products, a big number of people was compelled to produce food crops by making caiñgins as a temporary relief.

RESIN LICENSES

Past experience has shown the necessity of stricter control of the limited almaciga stand in the Islands. As fast as data are received, therefore, license agreements will be issued in the operation of all almaciga licenses as well as on other oil, resin or gum products if circumstances and other conditions permit. The present system of extracting the almaciga and balao resins is indeed very destructive that experiments will be made on the new cutting rule for the collection and extraction of almaciga.

STATISTICS

Statistics of licenses issued by provinces, forest products cut, forest charges collected, amount of fines, including the checking of auxiliary invoices, as well as the amount of rental for the use of forest land is being compiled by the Division and the increase of licenses as well as permits for the use of forest land in all its phase will require a considerable number of additional clerks.

SPECIAL PERMITS SECTION

The different uses of forest lands under Section 1838 of the Administrative Code have become gradually better known throughout the Islands and as a natural result, the work in this section had been greatly increased. At the close of the year there were on record 709 applications for leases and permits besides 32 minor forest product applications for exclusive license agreements.

Experience has shown that the leasing of forest lands for fishponds, saltworks or other purposes has also been used for speculative ventures by some applicants as in the case of ordinary forest licenses. At the outset an urgent step was necessary to check the practice and it was therefore imperative that radical changes be made in the established policy and procedure. For this reason the depositing of cash instead of personal bonds as a guaranty for the satisfactory compliance with the terms of the lease or permit has been required of all applicants before and not after the agreements for leases were prepared. The policy had a salutary effect as it was found that out of the 293 applicants who were requested to deposit bonds only 16 had been able or were willing enough to do so.

In the case of fishponds and saltworks, a bond of ₱20 per hectare was deemed sufficient although a conservative cost estimate for replanting one hectare of mangrove swamp would require approximately from ₱30 to ₱60. In pasture or residence permits, the payment of the annual rental in advance is the only necessary requisite, it being understood that the same will be forfeited in case of non-use of the permit granted.

SPECIAL USES

There has been issued during the year 11 lease agreements, 16 ordinary fishpond and saltworks permits, 54 pasture permits and 3 special uses as compared with 12 lease agreements, 13 pasture permits and 1 minor product license agreement granted in the year just past. Two lease agreements were cancelled during the year, thus making the total number in force as 21 lease agreements. Nine pasture permits granted in 1920 were extended to expire on December 31, 1921.

The following table will show the status of the applications on hand at the close of business for the year 1921.

Status of special permit applications on December 31, 1921

Class of applications.	Disapproved or cancelled.	Pending.			Number of—				Total number of applications, December 31.
		Inspection.	Bond.	Issue of lease or permits.	Lease issued 1921.	Permits issued 1921.	Lease in force.	Lease cancelled.	
Fishpond	136	26	273	8	6	14	6	2	471
Saltworks	10	6	12	2	5	2	5		42
Pasture	28	45		54		54			181
Residence	1			6					7
Special use				1		2			3
Sawmill site			2	2			1		5
Hotel or sanatoria			1						1
Nipa plantation	1			23					24
Bacauan plantation		1		3			4		8
Total	176	78	288	99	11	72	16	2	742

It will be noted in the foregoing table that ordinary saltworks and fishpond permits were granted, this being necessary in order to authorize the applicants to begin construction work as well as to legalize the collection of annual rental before the agreements for long term leases were prepared in proper form. No action were taken on application for special uses unless the area desired had been inspected and surveyed and that all possible doubts of ownership had been removed. Claimants are, in all cases, invariably given reasonable allowance to show proofs of ownership if not preference over all others to lease the area. This requirement, alone, among others, tends to delay the action on applications for special uses and that at best it takes about from six months to one year before the permit or lease is finally issued to an applicant.

In spite of the increased bulk of work in the section, however, the personnel had not been increased. The forest supervisor in charge had devoted his time to the checking of all reports and permits or leases issued while his assistant, a senior ranger, had been detailed on subjects pertaining to the Division of Investigation. During the last semester some changes in forms and procedure were adopted which resulted in a more efficient handling of the work than heretofore. The assignment of an additional ranger and another clerk is imperative, in order to cope with the increasing bulk of work.

PASTURES

The cattle industry in the Philippines is constantly growing and will become one of the most important industries.

Permits are now being granted for grazing on public forest lands and data collected to show the effects of grazing and proper control measures necessary to apply to this class of permits.

In the Non-Christian provinces, the issuing of permits has been in the hands of the Bureau of Lands under Act No. 2176, but the Attorney-General has been requested to give his opinion as to whether Act No. 2176 and Section 1838 of the Administrative Code do not conflict and as to which Bureau should have the control of this work in the Non-Christian provinces.

The control of this work in these provinces will, therefore, be based on the opinion rendered by the Attorney-General.

RESIDENCE

A tentative plan has been prepared by which squatters on forest lands will be put under proper control. It has been the practice of many *caiñgineros* to reside on or in the vicinity of their clearings and in many cases they declare the area as their private property, paying land taxes therefor. At other times they do not care to pay for their bit to the municipality but simply move from place to place without any permanent settlement. In order to check abuses, the Bureau proposes to issue in subsequent years ordinary residence permits to people found residing within the forest and for the use of which very moderate rentals will be charged.

Aiming primarily as a means to enable us to control squatters, the system may in itself become a possible source of revenue from land that would otherwise remain idle. It will, however, follow that the bulk of the work will correspondingly increase and that the necessary personnel will be required.

CAIÑGINS

The general business depression which occurred during the year has compelled a big number of people to produce food crops by the caiñgin system as a temporary relief measure. As a natural result there were issued by the local forest officers 2,592 caiñgin permits during the year. More cases of caiñgin violations are on record this year, there being reported 1,602 illegal caiñgin cases as against 721 in 1920. Six hundred seventy-three of the cases brought to court resulted in conviction as against 184 of last year. These results were obtained due to the continued coöperation of the Provincial Fiscals and Justices of the Peace as well as the increased efficiency of the field men in handling caiñgin cases.

It will be noted in the data given below that there were cleared during the year in violation of the caiñgin law some 1,500 hectares of forest land. The Government charges including surcharges on forest products burned, destroyed, or otherwise injured amounts to ₱178,943.91. The yearly destruction of valuable timber as well as the opening of virgin forest lands requires serious consideration on the part of the Government.

A radical change in the procedure in dealing with caiñgin violations has been inaugurated during the latter part of the year. This is by taking action on caiñgin cases either administratively through the Bureau of Internal Revenue or taking the matter up criminally before the courts. It is hoped that with this procedure many caiñgin cases will be promptly settled instead of having them held pending before the courts for months or sometimes for years.

The following tables show the number of caiñgin permits granted and the status of caiñgin cases reported from each province during the year:

List of caiñgins reported during the period from January 1 to December 31, 1921

Province.	Caiñgin agreement.	Collective caiñgin permits.	Caiñgin permits granted.	Caiñgin application disapproved.	Total.
Abra			246		246
Agusan			18		18
Albay				1	1
Antique			1		1
Bataan					
Batanes					
Batangas	1		1		2
Bohol					
Bukidnon					
Bulacan					
Cagayan			43		43
Camarines Norte			5		5
Camarines Sur			4		4
Capiz					
Cavite					
Cebu			4	3	7
Cotabato			5		5
Davao		8	347	7	362
Ilocos Norte			1		1
Ilocos Sur			24		24
Iloilo					
Isabela			22		22
Laguna			14	8	22
Lanao			14		14
La Union	102		192	1	295
Leyte			116	22	138
Marinduque			1		1
Masbate			32		32
Mindoro			67		67
Misamis			24		24
Mountain Province			447	2	449
Nueva Ecija			2	1	3
Nueva Vizcaya			17		17
Occidental Negros			11	3	14
Oriental Negros			4	2	6
Palawan			310		310
Pampanga			1		1
Pangasinan			2		2
Rizal			154	5	159
Romblon			2		2
Samar			177	16	193
Sorsogon				1	1
Sulu					
Surigao			19		19
Tarlac			1		1
Tayabas			164	3	167
Zambales	1		12	10	23
Zamboanga			88	12	100
Total	104	8	2,592	97	2,801

Illegal caiñgins reported during the fiscal year from January 1 to December 31, 1921

By provinces.	Cases reported by forest officer.	Total area in hectares.	Total charges and surcharges.	Acted upon—				
				Convicted.	Acquitted.	Warned.	Invoices sent to municipal treasurer.	Total.
Abra	5	2.00	90.30				5	5
Agusan	9	6.28	872.80			3	5	8
Albay	67	51.00	4,035.72				36	36
Antique	12	10.95	437.76				5	5
Bataan								
Batanes								
Batangas								
Bohol	36	48.34	4,731.18	36				36
Bukidnon								
Bulacan	3	3.50	155.12	3				3
Cagayan	3	3.80	480.58	1	1			2
Camarines Norte	24	11.04	2,205.78	6				6
Camarines Sur	28	25.58	2,104.48	8			6	14
Capiz	1	1.50	233.96					
Cavite								
Cebu	24	19.75	1,950.57	13	8			21
Cotabato								
Davao	8	16.50	1,684.89			2	3	5
Ilocos Norte	9					9		9
Ilocos Sur	24	14.00	181.20	16	4		5	25
Iloilo								
Isabela								
Laguna	13	12.00	1,392.08	9				9
La Union								
Leyte	164	108.90	9,381.56	87			6	93
Manila								
Masbate	342	195.58	17,568.20	148			34	182
Marinduque	1	1.00	30.30				1	1
Mindoro	21	15.25	1,650.94	4	2			6
Misamis	19	14.00	2,768.66	18				18
Mountain Province	31					31		31
Nueva Ecija	4	8.50	665.78					
Nueva Vizcaya								
Occidental Negros	39	22.26	3,540.36	25			7	32
Oriental Negros	6	3.03	265.20	6				6
Palawan	4	2.50	811.22	1				1
Pampanga								
Pangasinan	12	5.22	302.34					
Rizal	34	25.50	800.40	26				26
Romblon	25	18.11	3,207.50	12	2			14
Samar	251	173.14	6,876.40	146	41			187
Sorsogon	90	52.50	9,299.56	37	11			48
Surigao	16	7.95	1,618.24	1				1
Tayabas	49	36.06	3,767.74	21			3	24
Zambales	95	64.64	6,962.79	54	1		27	82
Zamboanga	27	30.10	2,392.64			12	14	26
Total	1,496	1,005.48	92,416.15	673	70	57	157	957
Misamis[1]	106	424.00	86,527.76					
Grand total	1,602	1,429.48	178,943.91	673	70	57	157	957

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[1] All the auxiliary invoices on the 106 cases recently reported from Misamis are not as yet received at the Manila Office and only an approximate estimate was made from some of the reports now on hand.

PROPOSED SUPPRESSION OF ILLEGAL CAIÑGINS

1. The Division had always made it a point to attend to the forest destruction with the utmost vigilance. In line with detecting of frauds and illegal cutting of licensees and non-licensees, forest guards are employed for patrol purposes and all forest officers made it a point to investigate and take final action on all illegal caiñgin cases. The increase of the guards

for patrol work will, therefore, be a part of our aim in the course of the next five years.

2. The new procedure of dealing with illegal caiñgins will facilitate prompt settlement of any cases which would otherwise be pending for months. As rapidly as circumstances permit forest guards will be authorized to file criminal complaints before justices of the peace against violators whose caiñgins are detected in the course of their trips.

3. The suppression of the caiñgin evil depends to a great degree on the coöperation of the municipal officials and licensees and all forest officers will as heretofore endeavor to obtain that coöperation among all the people concerned. Licensees and holders of caiñgin permits are required to report to the nearest forest officer all violations which may come to their knowledge.

4. *Legislation.*—In order to suppress the caiñgin evil and to have the municipal authorities on our side, it is advisable that out of the fines collected on caiñgin cases by our courts or by the Bureau of Internal Revenue, as the case may be, should be given to the municipality where the caiñgin was made and the money should go into the municipal funds. Hence it would be necessary to draft a law to this effect.

FOREST DISTRICTS AND STATIONS

The northwestern part of Mindanao or the territory covered by the forest stations of Cagayan de Misamis, Kolambugan, and Dipolog (formerly District No. 8), was transferred to District No. 13 as it was found easier for the officer in charge of Cebu to visit this region than the district forester of Zamboanga.

All the territories covered by the municipality of Bangui, Ilocos Norte, have been segregated from the Vigan Forest Station (District No. 2) and added to the forest station at Claveria (District No. 1).

During 1921, the following stations were opened:

1. San Quintin, Pangasinan Province	District No. 4.
2. Mauban, Tayabas Province................................	District No. 5.
3. Mercedes (Daet), Camarines Norte Province	District No. 6.
4. Dipolog, Zamboanga Province	District No. 8.
5. Balabac, Palawan Province	District No. 9.

The forest stations at Paracale of District No. 6, Lucban of District No. 5, Cuyapo of District No. 4, and Dapitan of District No. 8 were closed. The forest station at Cotabato was burned on August 10 by the fire that also burned the provincial government building. All the records, supplies, and equipments of the forest station were also reduced to ashes.

SUMMARY OF REPORTS FROM FOREST DISTRICTS

The following are extracts from the annual reports of the officers in charge of districts. The majority of these reports contain considerable information which is omitted for lack of space.

District No. 1: Headquarters, Aparri, Cagayan.—Provinces: Cagayan, Isabela, and northern portion of Ilocos Norte. Area: 10,155.6 square miles.

The lumbering business in the district had been practically paralyzed although a few of the big licensees had steadily carried on their operations. The reduction of lumber prices by almost 40 to 50 per cent has also increased the inactivity of licensees. There is, however, a notable increase of licenses issued for tobacco curing-houses by 100 per cent over the last year's figure. The failure of the tobacco crops during the year has compelled laborers to work in the forest and the owners took advantage of the cheap labor then available.

The collection of rattan has been stopped in view of the failure of the tobacco business during the year.

A notable increase of violation is reported, a total of ₱12,587.31 in forest charges being of record as against ₱6,657.91 of last year.

A land classification party of 13 rangers from the Manila Office, aided by the district force, classified the Provinces of Cagayan and Isabela into "alienable and disposable" and timber lands in accordance with Act No. 2874. It is hoped that the settlement of public lands among other things, will result from this classification.

District No. 2: Headquarters, Vigan, Ilocos Sur.—Provinces: Ilocos Norte (except Bangui and Langangan), Ilocos Sur, and Abra. Area: 3,588.8 square miles.

In spite of the monetary crisis felt all over the Islands the licensees in this district operated continuously throughout the year and filled all local lumber demands. There is an increase of 24 ordinary timber and 43 minor product licenses over the number granted last year.

Silvicultural conditions have been very good, there being abundant reproduction of the important timber species from seedlings and sprouts. Sufficient seed trees are left all over the cutting areas and no signs of burning were noted.

Only cogon fires occurred but they did not in any way affect the existing stand, the areas adjacent to the forest being encroached by Parang and other second growth species. Only 27 caiñgin violations were detected, and 11 proposed communal forests were inspected during the year, the reports of which are still pending at the district office.

As a result of the demonstration plots exhibited and maintained during the last three years, there is a strong wish of the residents of the municipalities to have their communal forests replanted with valuable tree seedlings. The seedlings can be raised at the forest nurseries at barrio Baniao, Bantay, and barrio Agayao, Santa Cruz, Ilocos Sur.

District No. 3: Headquarters, Baguio, Mountain Province.—Subprovinces: Amburayan, Benguet, Bontoc, and Lepanto; and La Union (northern part). Area: 3,419.6 square miles.

While the construction of public and private buildings in Baguio had been curtailed in view of the financial crisis and the retrenchment policy of the Government, there was nevertheless an increase of some 1,500 cubic meters of timber invoiced by the two sawmills over the figures given last year. The records of the Benguet Consolidated Mining Company show a slump in their timber operations, having cut only 829 cubic meters or about 2,000 cubic meters less than last year's cut. In order to facilitate the transportation of timber and posts a 12,000 feet areal cable is just being started from the mines to their cutting area at Mt. Apalan.

There is also a notable increase in the exploitation of minor forest products, there being cut 2,000 cubic meters of firewood over the amount reported last year. Charcoal, fern tree and Christmas tree licenses were also issued, the latter being properly assessed by the Collector of Internal Revenue during the latter part of the year.

Although it was formerly decided to suspend the establishment of communal forest in the district, five communal forests have been inspected and one was resurveyed.

In addition to the Benguet Consolidated Mining Company, the Headwater Mines which had been operated more or less desultorily during the past years had also shared in the limited mine timber supply of the district. No other mining concern had resumed any active operation during the year.

The number of caiñgin permits issued during the year shows an increase of 173 over the number granted in 1920. Twenty-seven illegal caiñgins were detected but the authors of which were warned, it being their first offense. The intensive patrol work carried on by guards is giving satisfactory results in the decrease of forest violations within the confines of the Baguio forests.

The fire season this year has not been as severe as in past years. There were reported 47 fires, the biggest of which is 11 hectares in extent, the rest being from one-fourth of a hectare to 4 hectares. The total number of seedlings destroyed and poles killed or injured has come close to 15,000. The fire protection system has been revised so as to enable the firewarden to go to the scene of the fire with the least possible delay. A motorcycle has been provided for the purpose and the indications are that satisfactory results were obtained.

District No. 4: Headquarters, Dagupan, Pangasinan.—Provinces: Nueva Ecija, Nueva Vizcaya, Pangasinan, Tarlac, and La Union (southern part). Area: 8,718 square miles.

The timber market in the district has been greatly depressed by abnormal conditions that prices, as well as wood operations, had been considerably decreased. The proposed purchase of modern machinery from the States by one licensee has been postponed indefinitely. The four sawmills in the district had been run intermittently during the year. On the other hand, minor products such as firewood, camanchili bark, buri, rattan, etc., commanded better prices than those of last year.

The policy of prohibiting the exportation of timber cut within Pangasinan was raised this year, in view of the fact that illicit exportation has been rampant and it was not possible, with the limited personnel, to check the practice.

Auxiliary invoices covering ₱2,479 from licensees and ₱5,383 from non-licensees in the form of forest charges were sent out for collection during the year for forest violations. Thirty-nine illegal caiñgins were detected, six of which were already brought to court resulting into conviction. Of the thirty-three cases, the authors voluntarily offered to pay the forest charges of timber destroyed and to plant Ipil-ipil seeds on the area before abandoning the same.

The examination of areas applied for fishponds and pastures formed an important work in the district. There are of record 63 fishpond and 26 pasture applications received, most of which are as yet pending due to shortage of men.

The prevalent unsatisfactory silvicultural condition of the forest throughout the district remains unchanged. This is applied equally to the timber land as well as to mangrove swamps. Unless a reasonable increase in the personnel is given, nothing can be done to remedy the situation.

Reforestation experiment with planting of Ipil-ipil has been begun in Mangatarem, Pangasinan. Some 38 liters of Ipil-ipil seeds have been broadcasted during August of this year on four hectares of Government land.

The following interesting resorts and mineral springs were reported to offer unusual opportunities for recreation or exploitation:

1. Sual Bay.
2. Rocking Stone at Balincaguin, Pangasinan.
3. Warm Sulphur Spring of Mangatarem, Pangasinan.
4. Sulphur Spring of Santo Tomas, La Union.
5. Warm Salt Spring of Pugo, La Union.
6. Salt Spring of Salinas, Nueva Vizcaya. (Salinas Forest Reserve).

District No. 5: Headquarters, Los Baños, Laguna.—Provinces: Batangas, Laguna, Marinduque, and Tayabas. Area: 6,184.9 square miles.

No very great change has been noted in the lumbering activities in the district in contrast with that of last year. The number of licenses issued had been decreased in view of the fact that bonds are now required. There has been, however, a notable increase in the number of minor forest product licenses issued especially firewood, rattan, pili resin, etc.

Some 84 licensees committed violations of a minor character involving forest charges in the sum of ₱1,837.35. Three hundred and sixty-one violations of non-licensees were reported, the charges including surcharges being ₱9,087.63. Eighty-one illegal caiñgins were also reported in which forest products were destroyed, the forest charges on which amounts to ₱7,635.75.

A small sawmill has been established in Santa Cruz, Laguna, during the year. The sawmills in Calauag and Kabibihan had been operating steadily, in spite of business depression everywhere.

The land classification of a portion of the Province of Tayabas was carried on by members of the Division of Forest Lands and Maps and local officers have aided in the work. It is recommended that isolated mountain ranges in Batangas and Tayabas be surveyed and reserved promptly. Mt. Macolot on the shore of Lake Taal, Mt. Lobo, and Mt. Malapuño or Malaraya need special attention.

District No. 6: Headquarters, Naga, Camarines Sur.—Provinces: Camarines Norte, Camarines Sur, Albay, Sorsogon, and Catanduanes. Area: 6,665.5 square miles.

The lumbering industry throughout the district had been more or less dull and business in minor products of all sorts had been paralyzed due to the monetary crisis. The big licensees had kept up with their wood operation throughout the year, one having manufactured an average of from 5,000 to 8,000 molave ties a month and had reached 15,000 during the month of May. These ties are sold to the Sugar Centrals of the Visayan Islands and the Manila Electric Railroad and Light Company of Manila. The licensees in the eastern part of Albay had to suspend the manufacture of ties as the Manila Railroad Company had stopped purchasing same.

Fifty licenses were cancelled during the year for non-use and 93 of the 163 licenses were inspected. There were reported 73 violations of licensees amounting to ₱4,168.79 as against 43 and ₱1,841.18 last year, and 242 cases of non-licensees covering ₱7,688.87 as against 327 cases and ₱13,621.81 of last year. Twenty-six ordinary minor product licenses were cancelled and reduction in the number of licenses to 434 was observed. A corresponding decrease of 199 in caiñgin violation from that of last year is also noted.

In addition to the four sawmills reported last year, two sawmills, namely, the Tinalmud sawmill and the Mercedes sawmill begun operations during the year. The Denrica sawmill has just been installed and is under the charge of Mr. Fred L. Pray, former Chief, Division of Forest Management of this Bureau.

The opening of the Tabaco-Manila Railroad line via Pamplona, Pasacao, and Aloneros last October, greatly aided the facility of transportation in the district. The transfer of Paracale Forest Station to Mercedes, Camarines Norte, has proven to be satisfactory.

District No. 7: Headquarters, Iloilo, Iloilo.—Provinces: Antique, Capiz, Iloilo, and Occidental Negros. Area: 8,332.9 square miles.

A few of the big lumber dealers were able to report a fair showing in sales during the year. The majority of the licensees of timber and minor products have, however, been affected by the financial crisis and the abrupt reduction of prices by almost 50 per cent. The demand of lumber and ties for the sugar centrals was greatly curtailed due in part to the dull market and also to certain irregularities in the sales of ties on the part of some dealers. Soft wood species were represented to be of the first or second group to the great detriment of the interested parties.

There has been a notable decrease in forest violations among licensees and non-licensees. Invoices prepared against the former amounts to ₱4,275.45 and the latter ₱10,715.21. Caiñgin violations had also decreased by 50 per cent. The prosecuticn for criminal offense of illegal cutters have been tried in the district and had proved effective.

Among the most important work of the district is the inspection of mangrove swamp areas for fishpond purposes. Several questions on the ownership of old fishponds as well as to whose jurisdiction they properly belong were brought up and the Bureau should be prepared for the opposition of the registration of public property. This step is necessary in order to be able to conserve and restock the overcut mangrove swamps in the district.

District No. 8: Headquarters, Zamboanga, Zamboanga.—Provinces: Cotabato, Davao, Jolo, and Zamboanga (except Dapitan and Dipolog). Area: 22,576 square miles.

Lumbering in the district was doing fairly well in the early part of the year but when the financial crisis which today affects the world markets was felt in the Islands, licensees and mill operators were forced to suspend their operations. The low price of abaca and copra, the principal products in the district, has also greatly affected the local lumber business.

Statistics in the report show that 3 per cent of the total output of licensees and mill operators was shipped to foreign countries, 64 per cent to Manila, 19 per cent to Cebu, 7 per cent to Zamboanga, 1 per cent to Dumaguete, 3 per cent to other ports, and 3 per cent was used locally.

A short reconnaissance of the area under ordinary timber licenses of Mindanao Lumber Company in Margosatubig, Zamboanga, and the Port Lebak Lumber Company in Lebak, Cotabato, was made during the year. All concessions and one-third of the small license areas were inspected. Very little activity of holders of small licenses was reported.

There was very little demand for gutta-percha, almaciga, and beeswax. Rattan operation is practically at a standstill. But the local market for firewood and tanbark was fairly active.

The Hercules Lumber Company had a contract to fill timber demands of the Quartermaster, U. S. A., and also a million board feet to a firm in China. The company expects to put up another mill next year to double the output. The Basilan

Lumber Company, the Mindanao Lumber Company, the Port Banga Mill, the Port Lebak Company, the Flecha Point Mill as well as the other sawmills of smaller capacity suspended operations at different months during the year. Only the Olutanga, aside from the Hercules Lumber Company had operated continuously.

Only 18 caiñgin cases were reported to the Provincial Fiscal or Justice of the Peace amounting to ₱1,354.11, and all are by Christian violators. One thousand three hundred and seven caiñgin permits were granted—the increase being due to the paralyzation of the hemp industry. Collective caiñgin permits were also issued during the year.

The Hydnocarpus species, the fruit of which is the source of chaulmoogra oil for the cure of leprosy, is found to be in abundance in Basilan. An effort will be made to collect as many seeds as possible next year.

District No. 9: Headquarters, Puerto Princesa, Palawan.—Province: Palawan. Area: 5,617 square miles.

There were 51 ordinary timber, 27 gratuitous, and 216 ordinary minor products licenses issued in this district. As compared with the number of licenses issued during the previous year, there was a decrease of four ordinary timber licenses; an increase of 12 gratuitous lincenses and 46 ordinary minor products licenses.

Commercial depression which prevailed throughout the Islands, seems to have but very little effect on lumber business in this district. This is shown by the fact that a total of 28,642 cubic meters of timber was utilized in this district according to the invoices received from the Bureau of Internal Revenue, or an increase of 3,028 cubic meters over those of the previous year. The same is true with the minor forest products, an improvement having been noted on the demand for firewood, tanbark, gogo, dyebark, wood oils, and beeswax. This accounts for an increase in the number of licenses issued covering such products.

District No. 10: Headquarters, Tacloban, Leyte.—Provinces: Samar, Leyte (eastern part), Surigao, and Masbate. Area: 11,124.2 square miles.

The lumber business in the district was not seriously affected by the monetary crisis. Besides the 10 sawmills already installed and reported in 1920, 3 others were established during the year. With the exception of 2, all the 11 mills were in operation, 6 intermittently, and 5 continuously throughout the year.

The lumber market, although reported to be dull in the first half of the year, has shown a little improvement from July to December. This is characterized by the gradual influx during this period, of applications for timber licenses. The principal lumber markets in this district are Tacloban, Cebu, Iloilo, Negros, and Manila.

Masbate's production of lumber, however, was greatly curtailed due to the outbreak of rinderpest. Its product composes of ties and logs which are mostly of molave, macaasim, and batete, and sold to Cebu, Iloilo, and Negros for laying out railroads. Logs, mostly of narra, tindalo, and molave, were consigned to Manila and the rest were sold to the mining companies at Aroroy. These mining companies also consumed a considerable amount of firewood cut all over Masbate.

As before, minor forest products were marketed almost locally within the district. Tacloban, Leyte, is the principal market, especially for firewood. The quantity of rattan and other vines for tying purposes produced during the year was greatly reduced due to the weak abaca market although a good deal was shipped to Carigara, Leyte, and other towns where it was employed mostly for baling and fishing purposes.

There has been a notable increase of illegal caiñgins in the district, 630 cases having been reported as against 268 of last year. Some 789 illegal cutting against 352 cases last year were reported, the auxiliary invoices covering ₱19,944.94.

District No. 11: Headquarters, Manila.—Provinces: Bataan, Bulacan, Cavite, Pampanga, Rizal, and Zambales. Area: 5,106.1 square miles.

The lumbering business throughout the district had been practically paralyzed. All the licensees had felt the financial crisis during the year and with the exception of the Cadwallader-Gibson Lumber Company, their operations were greatly reduced if not definitely closed. The sale of manufactured bancas had, however, been constant in the eastern part of Bataan Province. The proposed installation of sawmills at various points had been also suspended.

There has been a big increase in the number of licensees this year. In the course of the inspection of cutting areas some 228 licensees were found to have committed minor violations and were imposed forest charges in the amount of ₱5,927.07. Some 699 non-licensees were detected cutting forest products valued at ₱9,062.68 in Government charges. Of the 117 illegal caiñgins detected, 78 were already acted upon at the close of the fiscal year.

It is recommended that holders of long term concessions be required to replant cut-over and abandoned areas with desirable tree species, such as yacal, narra, teak, etc.

District No. 12: Headquarters, Calapan, Mindoro.—Province: Mindoro. Area: 3,981.6 square miles.

There has been a considerable decrease of timber cut during the year due to the present business depression. A conservative estimate places 60 per cent of the timber cut last year as still lying in the forest without being transported. It is feared that unless the local market is improved, the same will be a total loss.

There has, however, been a notable increase in the number of minor product licenses granted during the year. There had been a constant, although limited demand for firewood, tanbark, rattan, almaciga, buri, diliman, and gogo, all of which find a ready market in Manila and other trade centers at slightly reduced prices.

There has been noted less violation in the cutting areas this year than last year. There is, however, a gradually increasing cogonal area due to the practice of homesteaders to abandon their areas and converting the same to grazing land. Only two illegal caiñgins were detected during the year.

Only seven parcels of communal forests were inspected and established during the year.

District No. 13: Headquarters, Cebu, Cebu.—Provinces: Agusan, Bohol, Bukidnon, Cebu, Leyte (western part), Misamis, Negros Oriental, and Zamboanga (northern part). Area: 20,531 square miles.

The lumber industry in the district has been at a standstill. All over, licensees and sawmill operators had closed and stopped operations due to the financial crisis. Ties and poles have, however, been in demand at the sugar centrals.

A reconnaissance of the coal mining region embracing the watershed of Manga River, north of the Talisay-Minglanilla Forest Reserve as far as Danao, Cebu, was made on March, 1921. A big tract of land had been proclaimed alienable and disposable under Act No. 2874 in the municipality of Ormoc, Leyte.

More interest is being taken on leases of mangrove forest, 92 applications being of record in the district office, 76 of which have already been acted upon.

There is an increase of 478 caiñgin permits over the number issued last year. Two hundred eight caiñgin violations were reported 156 of which were convicted, 14 acquitted and 6 forest charges collected; or an increase of over 100 per cent in caiñgin violation. This is due to the declaring of public land as private property for taxation purposes and erroneous propaganda by some local officials.

Several cogon fires occurred within the Talisay-Minglanilla Forest Reserve, destroying 600 baguilumbang and a few teak. Some 75 trees were also cut by a caiñginero within the plantation.

DIVISION OF INVESTIGATION

RECONNAISSANCE

The reconnaissance carried on during the year by this Division was confined to the Makiling National Botanic Garden. The class of 1922 spent the months of April and May in intensive reconnaissance on four blocks adjacent to the school. Practically the entire area from the peak to the northern boundary line between Cambontoc creek and the Military reservation was mapped and a timber estimate made. Considerable information of value was obtained and this will serve as the basis of a working plan for the garden.

Topographic and vegetative maps have been prepared for the entire area and also for each of the four blocks into which the area was divided, the scale of these maps being 1:5,000 and the contour interval 10 meters. These maps are the most accurate that have been prepared for the mountain and will serve as a basis for intensive management in the future. Stand tables have also been prepared for each block showing the number of trees and volume by diameter classes for each species in the 1st, 2nd, 3rd, and 4th groups. The work was conducted as follows:

(*a*) Boundary surveys were run for each block by the use of compass, chain, and Abney Hand Level.

(*b*) The blocks were mapped and estimated by parallel strips 200 meters apart running from the northern boundary of the forest. Elevations and bearing were taken at all topographic features on each strip. Notes were also taken regarding vegetation, soil, cultivated areas, trails, etc. Stand tables were then prepared for each strip and the figures in these tables combined to form a table showing the total amount of timber standing on the strips surveyed in each block. These figures were then divided by the total number of hectares estimated thus giving a final stand table showing the stand on the average hectares. From this final stand table other tables will be made showing the total stand in each block. About 10 per cent of the area of each block was estimated.

The results of this reconnaissance will be submitted in a separate report as soon as all computations and maps are finished.

The class of 1922 showed exceptional ability in this work and a considerable larger area was completed than was at first thought possible. Unless other work of more importance arises in 1922 it is intended to continue the reconnaissance in the Botanic Garden, extending through the Dampalit region and the Calamba Estate and possibly the Santo Tomas area. If this work can be finished in 1922 the area remaining on the southern side of Mt. Makiling can be completed in 1923, thus giving complete information and maps of the entire area. A full report of forest conditions will be prepared when the work has been finished.

DENDROLOGY

All the work done in this subject was in connection with the instruction given in the Forest School. All available data is being collected in order that the records may be brought up to date and obsolete names eliminated and proper common and scientific names recorded for all tree species in the Philippine Islands. The following lists are being checked and brought up to date:

1. Check list of the ferns and flowering plants of the Makiling Region.
2. Check list of woody plants of the Philippines in their family order.
3. Alphabetical list of all common names of woody plants of the Philippines.

Additional collections for the Forest School herbarium were made and considerable material obtained from the Manila Office. At present we have on hand 2,528 botanical specimens representing 114 families, 490 genera, and 1,069 species.

UTILIZATION

a. *Lumbering:*

No work of an investigative nature was done this year in lumbering due to lack of personnel and funds.

During January, the class of 1921 visited the lumbering operations of the Cadwallader–Gibson Lumber Company at Limay, Bataan, in connection with the course in Forest Engineering IV.

b. *Minor Forest Products:*

(1) *Mangrove Swamps—*

The study as outlined and used in 1920, was continued this year.

(*a*) A volume table based on 145 trees was prepared.

(*b*) The per cent of solid wood in stacks of round and split firewood was determined.

(2) *Rattan—*

Various species of rattan are being studied in order to determine their character and qualities for various uses. Studies are also being made to determine the most efficient method of reproduction.

(3) *Charcoal—*

Two charcoal kilns were constructed near the Forest School, one having a capacity of 1½ cubic meters of wood and the other 5 cubic meters. The small kiln produces from 5 to 7 sacks of charcoal and the larger about 25 sacks. It may be noted that the large kiln is more efficient in producing charcoal than the smaller one, although the latter is more satisfactory for experimental purposes. These kilns were constructed by two Japanese laborers who were skilled in charcoal manufacture. To date, there have been two charges in the large kiln and six in the small. The increasing demand for charcoal for various uses has led to the starting of this work inasmuch as very little is known of the properties of the charcoal of various Philippine tree species. Charcoal obtained from known species is at present being analyzed by the Department of Organic Chemistry, College of Agriculture, under the direction of Dr. M. L. Roxas. Charcoal from identified trees will also be sent to various firms in Manila, which use charcoal, particularly those companies that use producer gas in internal combustion engines. It is also planned to send material to the Forest Products Laboratory at Madison, Wisconsin, to determine whether any of this charcoal will be of value in certain of the industries of the United States.

(4) *Other Products—*

Collections and data are also being gathered on other miscellaneous products, such as gums, resins, oils, etc. Some analyses have already been made of these materials at the College of Agriculture under the direction of the department mentioned above. There is considerable information yet to be obtained on the uses of various minor forest products and this work requires urgent attention due to its importance.

Volumes I and II of Bulletin 22, Minor Forest Products have already been published and Volume III, which is the last of this series, is now in press.

ENGINEERING

The engineering work laid out in 1920 was continued this year. The following work has been done:

(*a*) New topographic and type maps of a portion of the Makiling National Botanic Garden. These were made in connection with the reconnaissance mentioned on page 27.

(*b*) Additional bench marks were established on various parts of the Forest School grounds and on Mt. Makiling.

(*c*) Differential leveling was continued along the main trails on the mountain thus checking former elevations obtained by the Abney Hand Level.

(*d*) The preliminary location of a trail from the first peak to the second peak was made and also of a new trail from the Forest School to the Mud-Spring.

(*e*) Office work was as follows:

1. Reduction table for Abney Level and chain showing horizontal distance and difference in elevation.
2. Diagram for obtaining the difference in elevations from vertical angle and horizontal distance. Also another diagram for vertical angle and slope distances.
3. Complete plane table map of the Forest School.
4. Forest map of the Lobo region.

WOOD TECHNOLOGY

a. *Durability test:*

The woods in the durability test were examined again. This test is still in progress and those which were still sound consisting principally of molave, yacal, ipil, acle, narra, narig, mangachapuy, treated hand specimens, regular durability test pieces from Lamao, Bataan and all American specimens in Series C were buried again for further study next year.

b. *Wood collections:*

The wood collection was increased this year by a large number of specimens from the Bureau including many foreign hand specimens. At present we have on hand 1,281 hand specimens of Philippine wood and 480 foreign specimens.

FOREST MANAGEMENT (INCLUDING MENSURATION)

a. *Growth studies:*

The annual measurement of 590 trees, comprising the eight principal species found in the Makiling National Botanic Garden, was taken in May and June. Growth figures were computed although no separate report was rendered. Results so far obtained indicate a growth per cent as follows:

Species.	Per cent.
White lauan	2.61
Taluto	1.96
Guijo	1.79
Amugis	1.64
Tamayuan	1.16
Katmon	.72
Camagon	.62
Duñgon	.52
Average	1.38

The annual measurement of all trees in the plantations was continued also. Valuable information is now at hand on the growth in early life of various commercial species.

b. *Working plans:*

The data secured during the reconnaissance held in the last dry season is complete enough to serve as the basis for an intensive working plan of a portion of the Botanic Garden. Four blocks have been covered and topographic and type maps, stand tables, forest and soil description, etc., are now available. In addition the Puting Lupa Block has been divided into ten compartments and an intensive study of each compartment is made.

SILVICULTURE

a. *Reforestation:*

During the year 1921, no planting was done in the reforestation plots established in previous years due to the lack of available funds. It was, however, possible to make an inspection of some of the plots in the Provinces of Ilocos Sur, Ilocos Norté, and Zambales, for the purpose of determining possible extension and improvement work to be done in the future. During this inspection, it was noted that the problem of reforesting the cogon areas is solved only by affording proper protection from fires and grazing. Until the areas planted are given proper care, very little or no success can be expected from this work.

(1) *Ilocos Reforestation*—

The plots visited during the year were those at Laoag, Sarrat, Santo Domingo, Vigan, Santa, and Santa Maria. Those not inspected were Pasuquin, Batac, Paoay, Sinait, and Lidlidda. The failure to inspect all of the plots was due to their inaccessibility during the rainy season.

In general, the plots are in good condition, considering the fact that they were not given proper protection from fire and grazing. Some of the ipil-ipil plants have already reached the height of about five meters and are bearing fruit. It is believed that in about five years' time the plots at Laoag and Sarrat will be completely covered with ipil-ipil.

The nurseries at Caniaw and at Santa are in a satisfactory condition. In both of these there are approximately 5,000 seedlings and transplants of narra, palomaria de la playa, ipil, teak, and molave ready for next year's planting.

Undoubtedly the crying need of the region is for timber and firewood. The economic condition of the people as regards to their timber supply is going from bad to worse. They are practically facing a timber famine. The reforestation of the Ilocos region is, therefore, a great economic problem that the Government should handle immediately.

The most urgent needs of the project are:

(*a*) Proper protection from fire and grazing.

(*b*) Close supervision of the work. This needs a man especially detailed for the work.

(*c*) Establishment of a nursery at Laoag.

(2) *Zambales Reforestation*—

Three of the four plots established in the Province of Zambales were inspected. The plots of the towns of San Narciso and San Antonio have been burned over and grazed resulting in a total failure. The plots of San Felipe had about 75 per cent success. Some of the plants were about two meters tall and bearing fruit. A nursery is needed in San Felipe. Proper protection of the areas planted is the most urgent need of the project.

(3) *Cebu Reforestation*—

No work has been done in the reforestation of the Talisay-Minglanilla Forest Reserve. Not even one guard has been employed to patrol the area, on account of the lack of funds. This has proven to be a mistake as squatters are beginning to clear off young molave trees.

(4) *Mt. Arayat Reforestation*—

A small amount of teak seed was planted by the caiñgineros in their clearings on the mountain, but the planting was almost a total failure. The necessity of reforesting the cogonal areas of Mt. Arayat has been emphasized in previous reports.

(5) *Cotabato Reforestation*—

No work has been done this year on account of the lack of funds. It is planned to renew the project next year.

(6) *Corregidor Reforestation*—

With the coöperation of the military authorities, the work in Corregidor was started on June 16, 1921. The work accomplished consisted of the preparation of an outline of a plan to carry out the planting project; the establishment of a nursery, one hectare in area; teaching a short course in forestry at the vocational school; planting; and the marking and identification of trees along the main road and around the officers' quarters. After putting the project in good running order, it was left with the military authorities for continuation.

(7) *Makiling Reforestation*—

There was comparatively little work done this year due to the lack of transplants, there being only 14,149 plants and 1⅛ gunny sacks of seeds planted on the caiñgins. The percentage of success is low due to the lack of funds for labor to perform the planting efficiently, coupled with the lack of a trained man to supervise it.

(8) *Summary of Reforestation*—

All of the projects enumerated above are unfinished and they should be carried on next year. Urgent pending projects to be carried out next year are the following arranged in the order of importance:

(*a*) Establishment of forest nurseries at San Felipe and San Antonio, Zambales.

(*b*) Establishment of a forest nursery at Laoag, Ilocos Norte.

(*c*) Establishment of reforestation plots in La Union.

(*d*) Planting in the Salinas Forest Reserve, Nueva Vizcaya.

(*e*) Inspection of the proposed reforestation area near Bamban, Tarlac.

(*f*) Inspection of the Jolo Teak Reservation.

(*g*) Inspection of the Cagayan Valley for reforestation.

(*h*) Inspection of the Friar Lands at Sucat, Rizal.

Other projects which will require attention within the next few years are:

(*a*) Reforestation of the Agno River watershed to prevent erosion and excessive run-off.

(*b*) Reforestation along the Lagnas River in Tayabas where floods annually cause numerous washouts and much destruction of property.

In conclusion, it may be stated that next to the actual administration of the Philippine forest, reforestation is the most important single problem with which we have to deal and therefore requires immediate attention and large appropriations for the work.

b. *Nursery:*

As mentioned in the 1920 report the nursery was moved from the old site near the Foxworthy cottage to a location nearer the school. It is situated in Hectares D and F. This area has been improved considerably during the past year by additional plantings, the construction of a nursery house and the installation of a pipe line to all parts of the area. Cement culverts were constructed in necessary places.

c. *Arboretum:*

New plantings are being made in the arboretum from time to time as material becomes available.

d. *Reproduction Studies:*

The reproduction plots established in the logged over areas of the Cadwallader-Gibson Lumber Company in Bataan were inspected in January. Six of these plots were established in 1913 and the rest in succeeding years. There are thirteen plots and all were found.

e. *Seed Collection and Distribution:*

More seed was received this year than in 1920. Considerable amount was collected here by the students, guards, and laborers and numerous consignments were received from the field force. Large quantities of teak and baguilumbang were also received. The field force is to be complimented for its coöperation in furnishing the seed. However, we are still unable to meet the demands made upon us for seed and will require considerable more in 1922 than we have in the past year.

During the year, 3,044 liters of seed of various species were received here, 3,012 liters from the Philippines, and 32 liters from foreign countries.

The following is of great interest:

Two lots of seeds, one of Hydnocarpus hutchinsonii and the other of Hydnocarpus anthelmintica (family Tiaceae) were received, the former from Basilan Island and the latter from the "Jardin Botanique" of Saigon, China. Seeds of these species yield a very excellent substitute for chaulmoogra oil which is used in the treatment of leprosy.

The following quantities of tree seed were distributed during the year:

Species.	Destination.	Quantity in liters.
Ipil-ipil	Pangasinan	242
Do	Pampanga	140
Do	Bureau of Forestry, Manila	30
Do	Bulacan	60
Teak	Ilocos Sur	80
Do	Makiling reforestation	80
Palms	Fort Myers, Florida	39
Various species	Corregidor reforestation	1,210
Miscellaneous	Numerous destinations	27
Total		1,908

f. *Plant Accessions and Distribution:*

Approximately 7,100 plants were received during the year, representing over 50 species. These were obtained from the following sources:

	Plants.
Forest Nursery, Baguio	100
College of Agriculture	500
Bureau of Agriculture	6,500
Total	7,100

Most of these were redistributed to various places for planting, especially to Corregidor Island.

During the year, about 35,950 plants including timber and ornamental tree species, bamboo, palms, vines, and herbs were distributed as follows:

Destination.	Number.
Corregidor Island reforestation	17,000
Caniacao Hospital (Cavite Naval Yard)	500
Camp Stotsenberg	50
Schools (Arbor Day)	85
Oriental Negros	25
Makiling reforestation	14, 150
College of Agriculture	60
Manila (Conservation League)	80
Miscellaneous	4,000

With our increased nursery facilities we will probably be able to furnish more plants during 1922.

g. *Plantations:*

No new plantations were established here during the past year due to lack of funds and labor.

h. *Cost Records:*

The cost records of seed collection and planting are still being kept up to date as they furnish valuable information in regard to collection, soil preparation, planting, etc., which will be of value in reforestation.

i. *Studies:*

In addition to the various studies mentioned under other headings in this report, work has been started on a complete silvicultural investigation of several commercial timber species, as follows: teak, molave, narra, yacal, and lumbang. This will be continued throughout the year 1922 and additional species taken up. Some important information has already been obtained.

FOREST ENTOMOLOGY

Professor H. E. Woodworth, of the College of Agriculture, has been conducting research work in this subject with the assistance of the ranger personnel of this Division. Valuable information has been secured in close proximity to the Forest School on insects which damage timber. Collections have been made and breeding experiments are being carried on at present. Much of this material is unknown and has been sent to other countries such as Austria, Germany, France, and the United States for identification by specialists in the various insect families.

PUBLICATION

As mentioned under Utilization b. (4), Volumes I and II of Bulletin No. 22, Minor Forest Products, were issued this year and Vol. III is at present in press.

No other publications were issued this year. A handbook for Philippine Forest Rangers is at present being prepared and it will probably be ready for press by December, 1922.

The Division has considerable information in its files which is being brought together and augmented by new information so that it will serve as a basis for future publications.

The publication of the Ranger resulted in the discontinuance of the Mountain Echo. It is hoped to transfer the Echo to Los Baños for publication thus making it the official organ of this Division and of the Forest School. It would then become a medium of educational value. Also the ranger force could keep in touch with the work here and secure information on various studies which are being carried on.

ADMINISTRATION

a. *Personnel:*

The present force of this Division consists of one Chief of Division who is In Charge of the Forest School, one District Forester, one Forester in Charge of Silvicultural Investigations, one Forester on Special work in Engineering, one Forester in Charge of Reforestation, three Senior Rangers and three Rangers on special work, one clerk, and one librarian. Of the above, Forester Cuzner, Ranger Seguerra, and Clerk Aspiras are recent additions to the staff.

The non-technical force consists of three forest guards, four nurserymen, and approximately fifteen laborers. The guards are used in the administration of the Makiling National Botanic Garden and for making collections. The nurserymen are all working in the nursery at the school.

b. *Makiling National Botanic Garden:*

The administration of the Botanic Garden was transferred from District 5 to this Division on April 15, 1921. Since then efforts have been made to improve the forest by restricting cutting as much as possible. The extensive valuation surveys taken during the reconnaissance showed the necessity of stopping all logging except for designated species which are suitable for some purposes but these are not much sought after by licensees who prefer species which are now not represented on the mountain by seed-bearing trees.

The collectors of orchids and bird nest ferns are gradually destroying all such plants in the vicinity of trails but no adequate protective measures can be taken without more men to follow up and enforce any regulations which may be imposed. Students of the College of Agriculture and of the Forest School conduct their collecting work off the main trails in accordance with a long established policy of these institutions.

Hunting has been prohibited in accordance with the Executive Order of the Governor-General creating the Botanic Garden. However, some poaching has been done due to lack of guards for patrol work.

THE WORK IN BAGUIO

NURSERY AND PLANTATION

The work in the nursery consisted of preparing seed and transplating beds, manuring, cleaning, mulching, and making nursery frames and seed flats for the propagating house. A garage for the motorcycle used in fire-fighting was built and considerable amount of repair work was also done. The work of placing semi-permanent labels in the nursery and especially in the Experimental Plantation was pushed this year to completion.

The planting this year consisted of about 18,930 cuttings of such much used and valuable species as the cypress, camphor, *Hydrangea, Pyrus, Viburnum,* etc. The success of this year's planting of cuttings is only 6 per cent.

Several shipments of foreign seeds including the valuable and interesting genera of *Cedrela, Dalbergia, Rhododendron, Pistacia, Juglans, Aleurites,* and *Cinnamomum* were obtained, but in all cases the seeds were old and failed to germinate. Of all the exotic species from various sources, a germination of less than 5 per cent was secured.

During the year, 2,929 plants were distributed free of charge, as follows:

For city planting	761
For private parties	527
For other Government branches	346
For experimental plantation	1,295

There are on hand at the nursery 7,673 trees, 4,675 shrubs and small trees, and 4,479 herbaceous plants for use in the planting season of 1922.

The following species were planted in the plantation this year: *Bignonia catalpa, Callistemon salignus, Cassia corymbosa,* Kapok (*Ceiba pentandra*), Camphor, *Pinus insularis,* and Idog (*Viburnum odoratissinum*). Kapok (*Ceiba pentandra*) does not promise to succeed in the altitude of Baguio.

Another reforestation experiment is that started at Km. 3 on the Baguio–Trinidad Road. Here a steep hill, totally denuded and with bare stones showing from its top to half way down its slopes, was planted up to *Eupatorium* with the hope that these will suppress the grass which is set on fire every year.

Of the species given in last year's report, the *Castanea japonica* and *Juglans cordiformis* are reported to have died and *Umbellularia californica,* the Japanese cherries, and *Pithecolobium dulce* as doing poorly. All the others are in healthy condition.

FORBES PARK

The addition of stone benches to the permanent features of Forbes Park was completed this year.

The young stands of pine were pruned of their lower branches.

Flower beds were added this year to give interest and color to the scenery but this was only possible near the Forest Station where some degree of control can be exercised over the Park users.

Some of the interesting plants in the park were labelled conspicuously.

The swimming pool was enlarged and deepened this year.

The Kiosko at the picnic grove was improved in appearance and usefulness by the placing of a water proof board roofing.

The 200 chestnut trees set in 1910 in Forbes Park had fruited this year for the first time but due to the closeness of the original planting, it had been found necessary to transplant them anew to relieve crowding.

CITY COÖPERATION

The City of Baguio appropriated this year the sum of ₱5,000 for city planting and maintenance.

The city force was employed in watering and cleaning around the plants, trimming and pruning trees in preparation for the windy season, digging up plants in Forbes Park, and also in preparing the trails and bridges for the tourist season.

The District Forester has coöperated actively with private parties who have signified their desire to beautify their home surroundings.

FIRES

The acquisition of a motorcycle has facilitated the transportation of fire fighters to the places where needed. There were 44 fires put out this year (38 last year) with an area of 65½ hectares burnt over while last year the area burnt over aggregated 108 hectares. The fire damage has been reduced to half and with better methods of fire detection and reporting, the damage may be reduced considerably.

FOREST CONSERVATION

No reports of shortage of firewood and lumber were received from any source this year.

The demand for firewood, however, is larger than last year's, making it imperative that the plans to reduce consumption of firewood be carried out.

The cutting of firewood within the city limits has been greatly reduced during this year, being only about 1,700 cubic meters.

There is a full realization of the lumber and firewood situation in Baguio by other Government officials specially the Mayor of the City. It is also gratifying to note a laudable degree of understanding and appreciation of the Bureau's forest policy by others with the result that this year there was a smaller number of requests to deny, such as for marking trees on closed areas, for cutting immature trees and saplings, for caiñgins on wooded lands, etc.

Thus the Bureau of Forestry has partially succeeded in averting the wood crisis in Baguio by following the program set forth in the working plan of the District Forester for the Baguio Working Circle. But the augmenting of the firewood supply by planting fuel producing trees is a problem that remains to be solved by this Bureau.

FOREST SCHOOL

ENROLLMENT

The school work during the year 1921 started on January 10, after the Christmas vacation. The enrollment consisted of fifteen seniors and twenty-six juniors, four of the latter being British North Borneo pensionados. The graduation exercises of the class of 1921, consisted of a class day program held on the afternoon of March 18, and the commencement exercises on March 19, 1921. After a short talk by the Dean of the Forest School, diplomas were presented by Acting Governor-General Yeater with appropriate remarks. Other speakers during the commencement exercises were Prof. Cuzner, who was then at the College of Agriculture, and Mr. Justino Seguerra, the Medalist, who represented the class. The other honor men of the Class of 1921 were Gregorio Zamuco, first honor man and Jose Makil, second honor man.

The school year 1921–1922 opened on April 11, with an enrollment of 30 juniors, who began their summer work in botany immediately thereafter. Of these, four resigned before the opening of the regular school year in June and four more were dropped on account of poor scholarship. To fill these places, seven students who had had Botany I at the College of Agriculture were enrolled. Five of these were British North Borneo pensionados.

The senior forestry students spent the summer term in making a reconnaissance of a portion of the Makiling National Botanic Garden. Field work began on March 29, 1921 and ended on May 14, 1921. One member of the senior class, who was a Borneo pensionado, was dropped due to poor work.

At the end of the first semester, two members of the junior class were dropped for unsatisfactory work, and one was forced to resign due to poor health. The enrollment at present consists of 25 seniors, two of whom are British North Borneo pensionados and 26 juniors, four of whom are also British North Borneo pensionados. Among the class of 1923, two are Igorots.

The following tabulation shows the present enrollment by provinces at the Forest School.

Cagayan	2	Bulacan	1
Ilocos Norte	4	Laguna	4
Ilocos Sur	1	Camarines Sur	1
Abra	2	Albay	1
Isabela	2	Sorsogon	2
Mountain Province	2	Iloilo	3
La Union	2	Samar	2
Pangasinan	6	Leyte	3
Nueva Ecija	1	Cebu	2
Tarlac	3	Surigao	1
Zambales	5	Misamis	1
Total			51

FACULTY

All classes were taught at the Forest School this year. No work was given at the College of Agriculture on account of the loss of time in going to and fro. Furthermore the College of Agriculture has been handicapped due to lack of instructors and was therefore unable to give any outside courses.

No vacancies have occurred in the Forest School faculty this year. Two new members have been added to the staff, namely, Harold Cuzner, Professor of Dendrology; and Justino Seguerra, Assistant in Forest Engineering and Management.

IMPROVEMENTS

The following improvements were made at the Forest School during the year 1921.

(*a*) Installation of a water distillation plant. This is a great improvement as it furnishes good drinking water for all the students and faculty.

(*b*) Repair of the Forest School road. The repair of the Forest School road was commenced and the unfinished portion back of the school completed.

(*c*) The pipe lines were extended to the quarters and the new nursery, thus furnishing water at places where it was badly needed.

(*d*) A short cut trail from the Forest School road to the swimming pool was constructed by the students in connection with their classwork in Engineering IV.

(*e*) The hut on the top of Mt. Makiling was repaired by the students early in the year.

(*f*) A new nursery containing a potting house, seed and transplant beds, was established near the school in order to be readily accessible for student work and to carry on special experiments and care for important species.

(*g*) A nursery house with concrete floor, bamboo walls and nipa roof was constructed.

(*h*) The excavation under the Forest School was continued for 30 feet, thus giving ample space for storage and enabling us to construct two bodegas where stock may be kept under lock and key.

(*i*) The student dormitories were completely re-roofed with nipa inasmuch as they were in bad shape and badly leaking.

(*j*) Some planting was done along the Forest School road and around the quarters.

(*k*) Considerable minor repairs were made on and in the Forest School building, faculty cottages, mess hall, dormitories, etc., in order to keep them in good shape.

(*l*) Collections for the Forest School museum were continued throughout the year and considerable material of value gathered.

(*m*) The student gardens have been extended and kept under constant cultivation, thus serving as a source of supply for the Forest School mess.

SPECIAL FEATURES

The class of 1922 spent six weeks on reconnaissance work in the Makiling National Botanic Garden and considerable information of value was obtained. The maps especially are excellent and will serve as a basis for a complete map of the Botanic Garden when the rest of the reconnaissance is finished. This phase of the work is discussed under the heading "Reconnaissance" in the annual report of the Division of Investigation. The class of 1921 spent two weeks at Limay, Bataan, in a study of lumbering operations. The reproduction plots established there in the year 1913, were inspected by the class.

During the year the school was visited by many prominent people and organizations, among which may be noted: The Java Educational Commission; the Chinese Educational Commission; Acting Governor-General Yeater; Capt. Wettengel, U. S. Navy, Governor of Guam; Major-General Leonard Wood, Governor-General of the Philippine Islands; Guy Potter Benton, President of the University of the Philippines; and Capt. Wooley, of the British Forest Service.

The visit of Major-General Wood was marked by the planting of two memorial trees, one for Theodore Roosevelt and the other for General Wood.

ADVANCED COURSE

The advanced course leading to the degree of Bachelor of Science in Forestry was approved by the University Council and the Board of Regents during the year and it is hoped that the work in this course may be started by June, 1922, provided sufficient personnel and equipment can be secured. Not more than ten students can be cared for the first year due to the lack of equipment and class rooms.

Employment of Forest School graduates as of December, 1921

Employment	Class of—										Total	Per-cent
	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921		
Bureau of Forestry	8	15	18	8	11	13	16	19	17	15	140	64
Other Bureaus	....	1	4	3	1	....	....	....	1	....	10	5
Officers, U. S. Army	....	....	....	....	1	1	....	....	....	....	2	1
Officers Constabulary	2	4	1	....	....	....	....	....	....	....	7	3
Students, U. S.	2	1	1	2	1	1	2	....	....	....	10	5
Students, U. P.	....	....	....	2	2	....	....	....	1	....	5	2
Lumber business	2	2	3	1	1	1	....	1	1	....	12	5
Private business	2	4	....	2	1	3	1	....	....	....	13	6
Borneo Forest Service	....	....	2	....	....	....	....	....	....	....	2	1
China Forest Service	....	....	1	1	3	....	1	....	1	....	7	3
Guam	....	....	....	....	2	....	....	....	....	....	2	1
Deceased	....	1	1	....	....	1	....	....	....	....	3	1
Unknown	1	1	1	1	1	1	....	....	....	....	6	3
Total	17	29	32	20	24	21	20	20	21	15	219	100

A list showing the number of graduates from the provinces in the Islands and from China and Guam

Cagayan	12	Camarines	11
Ilocos Norte	9	Albay	6
Ilocos Sur	13	Sorsogon	2
Abra	1	Mindoro	2
Isabela	5	Capiz	8
La Union	4	Iloilo	10
Nueva Vizcaya	2	Samar	1
Pangasinan	26	Leyte	2
Nueva Ecija	7	Cebu	4
Tarlac	8	Bohol	3
Zambales	7	Occidental Negros	5
Pampanga	7	Oriental Negros	4
Bataan	2	Surigao	1
Bulacan	8	Zamboanga	1
Rizal	8	Misamis	2
Manila	2	Palawan	1
Cavite	4	China	10
Laguna	5	Guam	2
Batangas	6		
Tayabas	8	Total	219

DIVISION OF SAWMILLS AND UTILIZATION

While financial and market conditions existing during the year have brought a decrease of some 10,000,000 board feet in the volume of lumber sales as compared with the year 1920, production at the mills has shown material increase amounting to over 3,000,000 board feet for the mills at which regular scaling is carried on.

In spite of this increase in the scaling work at the mills at which scalers are stationed and the need of extending the work to those mills at which permanent scalers have not been previously stationed, the personnel in this division devoting the greater part of its time to scaling work has only been increased to 22 rangers and 28 guards as compared with 21 rangers and 24 guards in 1920.

Of this personnel the majority of the rangers devote a large portion of their time to other administrative and technical work while a large number of the guards are employed on a temporary basis under the provision of the appropiation act which permits the employment of personnel with savings from the regularly provided positions.

This has created a most undesirable feeling of uncertainty among the guard employees who are constantly on the lookout for positions outside of the Bureau with the natural idea that they are liable to be dropped at any time when they are kept on with only temporary appointments which must be continually renewed.

While it is true that new men can always be secured to replace those leaving the Bureau, the character of the work performed requires that each new appointee must spend considerable time at Government expense learning the work under competent instructors before he can be allowed to do regular scaling work which means a very considerable loss in money, time and efficiency of the personnel.

For this reason, as stated in previous reports, it is very desirable that special provision be made in the appropiations for a permanent corps of guard-scalers employed on a Civil Service rating who will devote their time under the supervision of the rangers or officers in charge of stations to the scaling of logs cut by licensees and in assisting the rangers in checking and supervising license areas.

During the year there were 52 mills in operation on license areas while regular scaling of all timber cut could only be carried out at 26 of these mills. Periodic scale and checking of an additional fourteen mills was carried on as forest officers were able to visit them during their field trips and at these 40 mills a total of 379,357 cubic meters of timber was scaled from January 1 to December 31, 1921, as compared with some 318,906 cubic meters during the same period of 1920.

GRADING

Through lack of funds and personnel, no progress has been made in the further training of lumber inspectors to take care of grading work.

With the trouble which has been experienced from the shipment of several cargoes of ungraded lumber to the United States a growing realization of the need of this class of work has been noted among the lumbermen which, it is hoped, will result in definite action being taken through the Philippine Lumbermen's Association for the general adoption of standard grading rules.

Over 1,000,000 board feet of ties and lumber have been inspected during the year at the request of various licensees in connection with their deliveries on contracts but practically no real grading work was done in these inspections, the certificates issued being confined to a statement of the species and merchantable condition of the timber.

Information has been received that several dealers have been negotiating contracts for delivery of export lumber specifying government inspection during the coming year but nothing can be done to meet requests for such an inspection involving the services of trained graders unless provision is made in the appropriation for the employment of additional guards to replace the rangers, to be trained in grading work, in carrying on the administrative work to which these rangers are at present assigned.

LUMBERING

With the opening of new mills during the year and the improvements made by a number of the old companies during the previous year, the production from the larger companies at which regular scalers are stationed has shown an increase of some 7,200 cubic meters (3,000,000 bd. ft.) although the continued depression of the market has brought a decrease in sales of 9,906,000 board feet during the same period from January to December, inclusive.

Reports from 21 companies show the following figures:

January 1 to December 31

Year.	Log scale.	Mill tally.	Sales.	Forest charges.
	Cu. m.	*Cu. m.*	*Cu. m.*	*Pesos.*
1920	309,787.28	221,286.21	218,694.54	265,806.16
1921	352,368.53	228,505.26	195,331.09	322,010.56

The accumulation of large stocks of lumber in the yards with a very slow market during the last half of the year compelled several mills to close temporarily although logging operations were continued so that a considerable stock of logs as well as lumber were on hand at the end of December, as indicated by the large scale compared with the mill tally.

During the year mills were installed by Rosenstock, Wrentmore and Reynolds, P. Chavez y Hermanos, Albert Bryan, Inc., E. A. Gebert, F. A. Percy, and Luis Martinez, while work was started or plans made for installation of new mills by the Butuan Sawmill, Inc., Albert Bryan, Inc., and Milbuk Timber Company.

LOCAL MARKETS

While sales have fallen off during the year as indicated in the table of lumber shipped given below, the steady, though relatively slow demand together with the continued large production of mills in operation and interest in installation of new mills, indicates a confidence in the lumber market and an underlying demand for lumber which will create a very active market as soon as a more normal financial situation will permit the resumption of building operations which are held up by lack of money.

The following table shows, by species and destinations, the volume of lumber sold by twenty-one of the companies from which regular reports are received:

Lumber shipped by twenty-one lumber companies from January to December, 1920 [a]

[In board feet.]

Destination.	Red lauan and tanguile.	White lauan.	Apitong.	Guijo.	Manga-chapui.	Lumba-yau.	Yakal.	Palosapis.	Miscellaneous.				
									First group.	Second group.	Third group.	Fourth group.	Total.
United States	3,942,736	1,922,384	187,826	....	....	559	....	....	....	....	....	15,094	6,068,599
Shanghai	876,564	425,466	130	....	....	....	....	....	....	....	....	4,103	1,306,263
Hongkong	....	212,227	....	....	....	....	....	....	11,293	....	....	....	223,520
Australia	....	....	....	....	....	....	....	....	....	....	....	2,511	2,511
Africa	11,087	13,601	....	....	....	....	....	....	....	....	....	....	24,688
Manila	11,729,112	19,910,705	12,927,652	1,825,151	162,345	2,348,415	1,617,526	646,415	684,102	18,415	564,082	3,942,468	56,866,388
Luzon ports	157,047	283,556	463,163	47,851	1,249	....	4,186	60,587	15,437	8,880	1,000,050	169,276	2,206,282
Cebu	1,006,224	501,752	706,779	116,520	28,290	244,101	75,900	....	4,569	7,294	34,642	420,846	3,146,917
Iloilo	483,751	898,828	74,265	7,348	592	....	578	....	....	....	....	103,840	1,569,202
Visayan ports	1,173,268	504,039	395,406	9,293	....	23,195	1,245	471	....	....	1,866,587	105,383	4,078,887
Zamboanga ports	126,917	535,609	280,986	96,282	19,560	438,333	54,587	....	9,098	51,736	54,763	201,455	1,869,326
Davao	50,998	95,000	814	1,641	....	1,815	30	....	186	....	....	115,146	265,580
Mindanao and Sulu ports	650,131	673,066	509,995	103,664	87,197	180,842	41,228	14,735	5,978	4,754	947	255,766	2,478,808
Unclassified ports	5,324,259	6,035,708	1,709,329	9,222	3,526	27,668	4,069	....	5,154	....	....	1,085	18,120,020
Total	25,532,094	32,011,941	17,356,345	2,216,972	252,759	3,259,928	1,799,349	722,208	735,767	81,079	3,521,071	5,336,973	92,726,486
Mill tally	23,057,496	29,840,094	19,592,357	2,931,265	347,074	2,457,750	1,910,599	1,174,166	831,409	518,688	3,223,256	2,941,199	93,825,353

[a] Three of these companies had no mill operations on public land.

Lumber shipped by twenty-one lumber companies from January to December, 1921

[In board feet.]

Destination.	Red lauan and tanguile.	White lauan.	Apitong.	Guijo.	Manga-chapui.	Lumba-yau.	Yakal.	Palosapis.	Miscellaneous.				
									First group.	Second group.	Third group.	Fourth group.	Total.
United States	1,906,861	1,361,916	448,810	182,564	....	2,018	....	30,563	....	....	....	53,033	3,985,765
Africa	7,657	5,899	....	....	....	....	....	....	....	....	....	....	13,056
Australia	336,797	199,618	....	....	....	....	....	....	....	....	....	....	536,410
England	66,101	32,827	....	....	....	30,054	....	....	....	....	....	....	128,982
Shanghai	1,445,388	1,044,674	180,024	....	....	46,288	....	....	....	....	....	....	2,716,374
Manila	12,062,736	17,595,805	12,663,158	1,976,701	258,654	1,776,920	1,515,118	352,655	416,117	144,325	1,455,545	4,458,360	54,676,094
Luzon ports	272,744	424,508	557,462	60,453	7,134	32,811	3,053	150,541	16	1,029	349,337	1,994,811	3,846,765
Cebu	1,180,340	949,514	1,542,656	151,213	30,362	354,113	157,506	....	2,698	1,500	4,989	686,861	5,061,752
Iloilo	1,021,230	1,035,722	452,798	20,761	7,403	12,718	19,721	....	232	39,816	68,850	....	2,679,246
Visayan ports	3,147,172	153,108	1,061,975	28,076	2,393	37,990	9,691	....	301	....	456,640	872,585	5,769,931
Zamboanga	352,964	317,975	208,968	76,780	9,322	349,782	113,718	....	18,622	3,007	49,829	301,319	1,802,286
Davao	50,162	11,191	10,806	....	....	....	897	....	....	....	1,613	....	74,669
Mindanao and Sulu ports	684,092	312,750	170,095	83,127	15,056	83,291	59,439	....	15,904	2,348	14,318	81,502	1,521,922
Total	22,534,244	23,445,002	17,296,752	2,579,675	330,324	2,725,980	1,379,143	533,759	453,890	192,025	2,401,121	8,448,471	82,820,386
Mill tally	32,416,640	26,586,865	20,981,782	3,474,489	480,205	2,167,043	2,399,314	858,443	870,464	866,160	3,702,631	2,132,194	96,886,280

The figures in these tables show local shipments of 85,101,000 board feet for 1920 and 75,440,000 board feet for 1921 as compared with 7,626,000 board feet and 7,381,000 board feet, respectively, of foreign shipments but while these figures indicate the approximate proportion of local and foreign sales, the actual foreign sales are somewhat larger owing to the fact that a number of shipments from these mills reported as sent to Manila were actually reshipped to foreign ports, accurate data for which could not be secured. These shipments are, however, included in the table of total exports of lumber from all sources.

FOREIGN MARKETS

The actual volume of exports during 1921 has decreased below that of 1920 by some two million feet while imports have shown an increase of some three million feet. Much of the increase in imports is made up of ties purchased from the United States by the sugar centrals to rush the completion of their railroads when their delay in arranging for cutting with local contractors left them short of ties for completion of the roads within contract time limits. Over 90,000 ties amounting to some 5,000 cubic meters were imported during the early part of the year to meet this rush demand for ties. With these imports of ties and the increase in lumber imports due to the decrease in prices of American lumber and freight rates the imports have increased from 18,488 cubic meters for 1920 to 25,520 cubic meters for 1921.

While the exports have dropped from 32,694 cubic meters for 1920, to 27,807 cubic meters for 1921, considerable development has taken place in the foreign markets other than the United States, exports to Australia showing a very sharp increase in addition to increases in shipments to Hongkong, China, Japan, and British Indies and new shipments to European countries and Singapore.

The following tables show the imports and exports as recorded by the Bureau of Customs, by species and countries. during the past four years:

Lumber and timber exported from the Philippine Islands

Species.	1921			1920			1919			1918		
	Cu. m.	Bd. feet.	Value.	Cu. m.	Bd. feet.	Value.	Cu. m.	Bd. feet.	Value.	Cu. m.	Bd. feet.	Value.
United States:												
Narra timber	106	44,944	₱6,450									
Tangile timber										31	13,144	₱1,015
Miscellaneous timber	18	7,632	1,101									
Narra lumber									₱50			
Tangile lumber	1,898	804,752	150,663	6,875	2,915,000	₱557,388	8,515	1,490,360	260,207	3,268	1,385,632	229,494
Almon lumber	2,352	997,248	124,843	1,892	802,208	111,877	459	194,616	18,504	1,056	447,744	35,450
Lauan lumber	4,576	1,940,224	438,892	10,014	4,245,936	446,879						
Miscellaneous lumber	400	169,600	21,201	43	18,232	3,077	4,836	2,050,464	251,840	2,656	1,126,144	117,679
Total	9,850	3,964,400	743,150	18,824	7,981,876	1,119,221	8,810	3,735,440	530,601	7,011	2,972,664	383,638
Hongkong:												
Miscellaneous timber				48	20,852	1,000	252	106,848	5,912	168	71,232	10,815
Narra lumber										1	424	163
Almon lumber	40	16,960	1,865	88	37,312	2,486				2,693	1,141,832	42,787
Lauan lumber	158	66,992	6,281	501	212,424	19,169						
Miscellaneous lumber	2,214	938,736	87,388	416	176,384	37,324	1,278	541,872	52,572	1,165	498,960	37,279
Total	2,412	1,022,688	95,534	1,058	446,472	59,929	1,530	648,720	58,484	4,027	1,707,448	91,044
China:												
Narra timber							3	1,272	360			
Miscellaneous				1	424	250	43	18,232	5,050			
Narra lumber	1	424	150							10	4,240	1,082
Tangile lumber	130	55,120	16,815	24	10,176	3,714	535	226,840	17,890	8	3,392	395
Almon lumber	768	325,632	38,498							10	4,240	993
Lauan lumber	7,800	3,307,200	276,941	5,900	2,501,600	247 608						
Miscellaneous lumber	1,463	620,312	75,075	2,361	1,001,064	103,698	4,111	1,743,064	147,139	5,457	2,318,768	163,809
Total	10,162	4,308,688	402,479	8,286	3,513,264	355,270	4,690	1,989,408	170,439	5,485	2,325,640	166,229
Japan:												
Narra timber				1	424	150						
Miscellaneous timber			40	21	8,904	4,118	90	38,160	1,982			
Narra lumber	4	1,696	312			11			100			
Tangile lumber			12				5	2,120	500	7	2,968	1,180
Almon lumber												20
Lauan lumber	105	44,520	4,893									
Miscellaneous lumber	63	26,712	1,251	15	6,360	5,582	7	2,968	1,146	4	1,696	788
Total	172	72,928	6,508	37	15,688	9,861	102	43,248	3,728	11	4,664	1,905

Australia:												
Tangile lumber	38	16,112	2,252	117	49,608	10,301	22	9,328	1,677	4	1,696	174
Almon lumber	2,644	1,121,056	152,852	1,102	467,248	57,285	446	189,104	18,812			
Lauan lumber	1,710	725,040	81,858	480	208,520	25,850						
Miscellaneous lumber	85	86,040	4,464				99	41,976	6,296	9	3,816	252
Total	4,477	1,898,248	240,926	1,699	720,376	93,436	567	240,408	26,785	13	5,512	426
United Kingdom:												
Narra lumber				1	424	192						
Tangile lumber	195	82,680	18,386	793	336,282	58,764						
Lauan lumber	799	338,776	50,669	1,168	495,232	76,918						
Miscellaneous lumber	128	54,272	10,139	459	194,616	34,777						
Total	1,122	475,728	79,194	2,421	1,026,504	170,646						
Canada:												
Almon lumber				94	39,856	6,000						
Lauan lumber				203	86,072	12,538						
Miscellaneous lumber							362	153,488	14,964			
Total				297	125,928	18,538	362	153,488	14,964			
British East Indies:												
Miscellaneous timber				7	2,968	720	2	848	300			
Tangile lumber	2	848	173									
Miscellaneous lumber	24	10,176	2,296	13	5,512	1,711						
Total	26	11,024	2,469	20	8,480	2,431	2	848	300			
British Africa:												
Lauan lumber				46	19,504	8,000						
Singapore:												
Lauan lumber	43	18,232	2,827									
Netherlands:												
Tangile lumber	1	424	102									
Lauan lumber	7	2,968	161									
Total	8	3,392	263									
Netherlands Indies:												
Miscellaneous lumber							4	1,696	126			
Guam:												
Tangile lumber	6	2,544	400							9	3,816	680
Lauan lumber				10	4,240	1,000						
Miscellaneous lumber	26	11,024	864							143	60,632	6,876
Total	32	13,568	1,264	10	4,240	1,000				152	64,448	7,556
Hawaii:												
Lauan lumber	3	1,272	50									

Lumber and timber exported from the Philippine Islands—Continued.

Species.	1921			1920			1919			1918		
	Cu. m.	Bd. feet.	Value.	Cu. m.	Bd. feet.	Value.	Cu. m.	Bd. feet.	Value.	Cu. m.	Bd feet.	Value.
Spain:												
Narra lumber	......	......	......	1	424	₱550	......	......	......	......	......	......
Miscellaneous lumber	......	......	......	......	......	415	......	......	......	......	......	......
Total	......	......	......	1	424	965	......	......	......	......	......	......
All Countries:												
Narra timber	106	44,944	₱6,450	1	424	150	3	1,272	₱360	......	......	......
Tangile timber	......	......	......	......	......	......	......	......	......	31	13,144	₱1,015
Miscellaneous timber	18	7,632	1,141	77	32,648	6,088	387	164,088	13,244	168	71,232	10,815
Total timber	124	52,576	7,591	78	33,072	6,238	390	165,360	13,604	199	84,376	11,830
Narra lumber	5	2,120	462	2	848	753	......	......	150	11	4,664	1,195
Tangile lumber	2,270	962,480	188,803	7,809	3,311,016	630,167	4,077	1,728,648	280,274	3,296	1,397,504	231,873
Almon lumber	5,804	2,460,896	313,058	3,176	1,346,624	177,598	905	383,720	37,316	3,759	1,593,816	79,250
Lauan lumber	15,201	6,445,224	862,072	18,322	7,768,528	832,957	......	......	......	......	......	......
Miscellaneous lumber	4,403	1,866,872	202,678	3,307	1,402,168	186,584	10,697	4,535,528	474,083	9,434	4,000,016	326,648
Total lumber	27,683	11,737,592	1,567,073	32,616	13,829,184	1,828,059	15,679	6,647,896	791,823	16,500	6,996,000	638,966
Grand total	27,807	11,790,168	1,574,664	32,694	13,862,256	1,834,297	16,069	6,813,256	805,427	16,699	7,080,376	650,796

Lumber and timber imported into the Philippine Islands

Species.	1921			1920			1919			1918		
	Cu. m.	Bd. feet.	Value.	Cu. m.	Bd. feet.	Value.	Cu. m.	Bd. feet.	Value.	Cu. m.	Bd. feet.	Value.
From United States:												
Ties	5,023	2,129,752	₱205,732	......	......	......	......	......	......	74	31,376	₱659
Cedar timber	......	......	......	......	......	......	389	164,936	₱5,924	......	......	......
Miscellaneous timber	63	26,712	2,588	121	51,304	₱2,149	36	15,264	2,670	96	40,704	4,900
Pine lumber	1,043	442,232	56,864	2,545	1,079,080	110,172	4,612	1,955,488	247,845	6,235	2,643,640	202,008
Redwood lumber	1,123	476,152	89,568	851	360,824	55,185	871	369,304	30,333	1,294	548,656	37,210
Cedar lumber	......	......	......	270	114,480	11,164	37	15,688	2,355	499	211,576	7,223
Cedar box shooks	......	......	18,000	......	......	......	......	......	......	......	......	64,383
Miscellaneous lumber	12,979	5,508,096	374,679	9,687	4,107,288	451,662	6,657	2,822,568	242,285	4,088	1,738,812	117,084
Total	20,231	8,577,944	747,431	13,474	5,712,976	630,332	12,602	5,343,248	531,412	12,286	5,209,264	433,467

From Canada:												
Cedar timber	225	95,400	7,760									
Miscellaneous timber				69	29,256	1,743				7	2,968	680
Pine lumber				358	151,792	10,409						
Cedar lumber	164	69,536	3,588									
Miscellaneous lumber	3,676	1,558,624	100,749	3,231	1,369,944	82,147	1,062	450,288	43,719	742	314,608	16,357
Total	4,065	1,723,560	112,097	3,658	1,550,992	94,299	1,062	450,288	43,719	749	317,576	17,037
From Hongkong:												
Miscellaneous timber				6	2,544	237						
Cedar lumber				614	260,336	12,283						
Total				620	262,880	12,520						
From China:												
Miscellaneous timber	19	8,056	3,507	2	848	22	3	1,272	53	20	8,480	233
Miscellaneous lumber	424	179,776	17,174	142	60,208	4,044	29	12,296	510	50	21,200	724
Total	443	187,832	20,681	144	61,056	4,066	32	13,568	563	70	29,680	957
From Japan:												
Miscellaneous timber	8	2,592	75							25	10,600	985
Cedar box shooks												3,889
Pine lumber										17	7,208	608
Miscellaneous lumber	26	11,024	189			4	30	12,720	212	20	8,480	150
Total	34	13,616	264			4	30	12,720	212	62	26,288	5,632
From United Kingdom:												
Miscellaneous timber	7	2,968	146									
From Australia:												
Miscellaneous lumber	233	98,792	18,134									
From British East Indies:												
Miscellaneous timber	45	19,080	1,592	111	47,064	1,516	44	18,656	1,339			
Miscellaneous lumber	346	146,704	36,366	435	184,440	16,063	343	145,432	13,923	150	63,600	4,307
Total	391	165,784	37,958	546	231,504	17,579	387	164,088	15,362	150	63,600	4,307
From British West Indies:												
Miscellaneous timber										1,664	705,536	2,147
From French East Indies:												
Miscellaneous timber							3	1,272	96			
Miscellaneous lumber	116	49,184	832	13	5,512	32	7	2,968	239	26	11,024	752
Total	116	49,184	832	13	5,512	32	10	4,240	335	26	11,024	752

Lumber and timber imported into the Philippine Islands—Continued

Species.	1921			1920			1919			1918		
	Cu. m.	Bd. feet.	Value.	Cu. m.	Bd. feet.	Value.	Cu. m.	Bd. feet.	Value.	Cu. m	Bd. feet.	Value.
From Spain:												
Cedar box shooks	......	......	......	......	......	......	......	......	......	......	......	₱1,738
Miscellaneous lumber	......	......	......	31	13,144	₱1,302	......	......	......	......	......	......
Total	......	......	......	31	13,144	1,302	......	......	......	......	......	1,738
From Netherlands:												
Cedar box shooks	......	......	......	......	......	1,596	......	......	......	......	......	......
From Netherlands East Indies:												
Cedar timber	......	......	......	......	......	......	......	......	......	50	21,200	1,137
From Germany:												
Miscellaneous timber	......	......	......	......	......	......	......	......	......	20	8,480	1,589
Pine lumber	......	......	......	......	......	......	......	......	......	2	848	15
Miscellaneous lumber	......	......	......	......	......	......	29	12,296	₱556	......	......	......
Total	......	......	......	......	......	......	29	12,296	556	22	9,328	1,604
From Guam:												
Miscellaneous lumber	......	......	......	2	848	200	......	......	......	......	......	......
From all countries:												
Ties	5,023	2,129,752	₱205,732	......	......	......	......	......	......	74	31,376	659
Cedar timber	225	95,400	7,760	......	......	......	389	164,936	5,924	75	31,800	2,122
Miscellaneous timber	142	59,408	7,908	309	131,016	5,667	86	36,464	4,158	1,807	766,168	9,549
Cedar lumber	164	69,536	3,588	884	374,816	23,447	37	15,688	2,356	499	211,576	7,223
Cedar box shooks	......	......	18,000	......	......	1,596	......	......	......	......	......	70,010
Pine lumber	1,043	442,232	56,864	2,903	1,230,872	120,581	4.612	1,955,488	247,845	6,254	2,651,696	202,631
Redwood lumber'	1,128	476,152	89,568	851	360,824	55,185	871	369,304	30,833	1,294	548,656	37,210
Miscellaneous lumber	17,800	7,547,200	548,123	13,541	5,741,384	555,454	8,157	3,500,968	301,444	5,076	2,152,224	139,374
Total	25,520	10,819,680	937,543	18,488	7,838,912	761,930	14,152	6,000,448	592,059	15,005	6,393,496	468,119

It may be noted in the foregoing tables that the large volume of miscellaneous lumber coming from the United States and Canada is almost entirely Douglas fir and was recorded under miscellaneous instead of pine (Oregon pine) owing to the appearance of the name "fir" on the invoice recorded by the Bureau of Customs when Douglas fir is commonly known as Oregon pine in the Orient. This correction was not discovered until after the tables were made up.

The exports to the United States have decreased some 8,000 cubic meters during the year which may in a large measure be attributed to the falling off of the markets there but the indications are that the practice of a number of exporters of shipping lumber without reference to grade has had a detrimental effect on the market for Philippine lumber in the United States and that the continued delay in adopting standard rules by Philippine lumbermen with a force of competent graders to inspect every shipment before it is loaded on the steamers is causing a setback to the development of foreign trade in several countries which will bring greater trouble and expense to overcome in the future.

During the year the Philippine Lumbermen's Association was reorganized with one of its purposes of organization expressly stated to be the establishment of standard grading rules but as yet no appreciable steps have been taken by them to put such rules and a regular grading practice in force.

UTILIZATION SECTION AND WORKING COLLECTION

The section lost one valuable man through the retirement of Mr. E. E. Schneider, wood expert, in charge of the section. Mr. Schneider is a man of wide experience and has been in charge of the section since its formation. He has rendered valuable service to the Bureau and to the lumber industry as a whole. Upon his retirement the section remained unfilled until the arrival, in August, of the Bureau's pensionado to the United States who took specialized work in wood-technology and utilization.

There were a number of new projects taken up during the year. Among these are experiments in wood preservation which are being conducted in coöperation with the Atlantic Gulf and Pacific Company. In these preliminary treatments by pressure processes, it was found for the first time that apitong (*Dipterocarpus* sp.), the most abundant structural timber of the Islands, lends itself easily to impregnation, more so than the lauans, due to the comparative absence of thyloses in the pores. Several thousands of paving blocks and railroad ties were treated and as much as 17 pounds absorption per cubic foot, has been obtained. The blocks and railroad ties are now being tested for durability by the City of Manila and various railroad companies and sugar centrals.

One of the drawbacks in the use of molave, ipil, and other naturally durable woods is the prohibitive cost which amounts to about 45 centavos for each block of 3″ x 8″ x 5″ in size. Another objection is that molave and other first group woods, when used for paving blocks, are too hard and during the rainy season, the paved streets become so slippery that they have to be covered with sand to prevent the horses, etc., from sliding. This, as will be seen, not only endangers the lives of horses and men, but it also increases the cost of maintenance. Apitong, on the other hand, while not as durable as molave, incorporates those properties which are desirable in paving blocks; namely, moderate hardness, strength, and susceptibility to treatment. It might be added in this connection that the common species used in the United States, where traffic is much greater than in this country, is Douglas fir (Oregon pine), the strength values of which are much lower than apitong, being only equivalent to our white lauans. Furthermore, the blocks are smaller being only three to four inches high as compared with five inches ordinarily used in this country. The cost of treatment cannot, as yet, be given as the tests were made on a small scale; however, an idea may be obtained on available data of treating plants in the United States where the cost of treating a square yard of four inch blocks amounts to ₱1.10, assuming the cost of oil injected into the wood to be two centavos per pound and 16 pounds per cubic foot. The treatment of structural timber which is generally injected with 10 pounds per cubic foot cost about ₱20 per 1,000 board feet and for each additional pound of creosote, about ₱2 is added when the oil is at 14 centavos per gallon.

The use of creosoted paving blocks is almost universally adopted in all modern cities the world over. Coal tar creosote is a strong antiseptic and as large quantities of it are injected into the wood, it follows that its presence alone tends to keep the streets in a healthful and sanitary condition. Creosoted paving blocks are durable; they are superior to molave in durability once treated and it wears slowly amounting to about 1/32 of an inch on soft wood blocks a year. Streets are easily repaired and the surface can always be kept smooth at a very low cost. They are noiseless and, for this reason, are desirable in congested business districts.

As a result of these preliminary tests which are now being made on a semi-commercial scale, the above-mentioned company is seriously considering the establishment of a large treating plant for preserving native woods. This will redound in the greater utilization of apitong and other treatable woods as structural timber, because one of the drawbacks in the use of these woods is due, not to the lack of mechanical strength but rather, to their lack of lasting qualities.

The section also obtained valuable data on the microscopy of Philippine woods. These were incorporated in the researches of Forester Luis J. Reyes, formerly assistant wood-expert of the Bureau, performed in the United States while he was taking the higher course in forestry. The work, a microscopy of the woods of Philippine dipterocarps, is a detailed study of the woody structure and is useful in identifying closely related species of the family. There are now in preparation permanent mounts of the most important Philippine woods. There is a conspicuous absence of data on the anatomy of Philippine woods and the sections which are being prepared will furnish material for study. It might be stated that if the native woods are to be utilized intelligently, a thorough knowledge of their structure, etc., is essential.

Another work which was taken up during the year was a detailed study of the shaft industry. This industry employs crude methods of bending woods for shafts, thus breakage is unusually large amounting to about 25 per cent. This breakage can be easily lowered to about 5 per cent. One of the assistants in this section was detailed to make a thorough study of the shaft industry with a view of introducing modern methods of bending wood. Experiments are now being planned to determine the bending qualities of native woods. Data along this line are valuable for a possible bent-wood furniture industry similar to that of Vienna. There seems to be no reason why the Philippines with unlimited supply of wood of different mechanical properties cannot produce as good furniture as the Vienna products.

The section has coöperated with other Government offices, lumber companies, and other wood users in instituting proper methods of utilizing and handling lumber; likewise, with the City high schools in furnishing information and material such as wood and botanical specimens for study in biology. No less than 400 students visited the section for information regarding woods and minor forest products.

During the latter part of the year, one of the rangers stationed in the section was detailed to investigate the moisture content of green woods. There has never been heretofore any continued study made along this line and in two months field work there were accumulated much valuable data. This work confirmed the former belief that some of our woods such as pahutan (*Mangifera altissima*) and baniti (*Madhuca ramiflora*) contain over 100 per cent water based on their dry weights. While the ranger was engaged in this work, he was also detailed to make intensive collections of insects and fungi destructive to forest products. Very little attention has been paid to this study. The loss caused by insects and fungi to the softer dipterocarps alone amounts to hundreds of thousand pesos, but adequate measures of control other than proper brush disposal cannot be intelligently promulgated on account of lack of knowledge of the life history and the biology of these destructive agents.

There has already been assembled some 15 species of termites and about 25 species of fungi, together with notes on their habits, destructiveness, etc. The study of controlling termite destruction is now being investigated in coöperation with the zoölogy and chemistry departments of the University of the Philippines. The investigation consists of a thorough study of the habits of destructive termites by the zoölogist; the study of chemicals and methods of treatment by the chemists; and the study of structure and durability of woods in relation to termite resistance by the wood technologist.

BOTANICAL COLLECTIONS

There have been received during the year 458 botanical specimens, 134 of which were collected with wood specimens. Numerous trade samples have been collected but only 179 were retained as the others are already represented in the collection.

Among the most notable additions to the collection are ample materials of "Manggasalakag" (*Hydnocarpus hutchinsonii*) the seeds of which contain chaulmoogra oil which is a specific cure for leprosy. The seeds which were received in large quantity were distributed to the Bureaus of Agriculture and Science for propagation and analysis, respectively. There has been considerable difficulty in locating this species on account of the fact that it is little known even to the Moros. Forest officers stationed in Mindanao, especially in Basilan, have located numerous trees which are now being protected.

As a result of the request on the field force to collect logs and planks in order to replace those lost in the fire of 1920 Carnival, 32 logs and 35 planks have been received during the last two months of the year. The log specimens of guijo, batikuling, arangga, palosapis, and narra are valuable additions to the collection as these are either not previously represented or are exceptionally of large dimensions.

Thirty-five new planks have been added to the collection. One ten-foot plank of red narra, 54 inches (137 cm.) in width, is probably the largest specimen that has ever been brought to the market. No less notable is a plank of yakal, 53 inches (135 cm.) in width which is being loaned to the Bureau by the Mindanao Lumber Company. Two hundred and fifty-five wood specimens from eight different countries were received during the year, making the total number of foreign accessions 2,359.

There were distributed a total of 13,189 handspecimens during the year. Out of this number, 1,477 were sold, 4,946 furnished to Forest School, 2,381 distributed to different forest stations, and 4,385 distributed gratis. Besides these, 96 panels, mostly $\frac{3}{4}''$ x 6″ x 12″ in size, were sold to different concerns.

IDENTIFICATION, GRADING, AND INSPECTION

The number of specimens submitted by lumbermen, forest officers and others dealing in wood run to several hundreds. Aside from these, the section goes over all timber invoices made during the year. This work was found necessary in view of the fact that many invoices submitted to municipal treasurers and other deputies of the provincial treasurer contain misclassified species. In this connection it was found that one of the best means to minimize misclassification which results in loss of revenue to the Government, is to compile a sort of dictionary of local names giving their equivalent official names. This was made from available data and is now ready for the press.

There were submitted from Sumatra, 87 specimens for identification. Practically all of these were determined to the genus and a few to the species. This work of determining wood samples from abroad is made possible on account of extensive collection of foreign material which is now systematically arranged in the Utilization Section.

There have been numerous requests by local lumbermen to certify the identity of samples which they submit to their dealers abroad. The samples were sent to various European countries, United States, China, and Japan.

The amount of timber inspected and measured during the year is as follows:

	Board feet.
Logs	371,135
Piles	137,994
Lumber	176,998
Total	686,127

These figures do not include shipments of timber of which indentification only is wanted.

CARPENTRY SHOP

The small shop which the Bureau maintains, prepares logs, planks, and other specimens for the Wood Technologist's Office and Museum. It serves as a laboratory for the section because, in working the planks and log specimens, a correct knowledge of their working and finishing qualities is gained.

The work of rearranging the forest products showroom was entirely done by the carpenters of the Bureau. During the year the shop made 14 tables, 5 desks, 2 sections of library shelves, 113 panels, 22 floor specimens, 3,198 hand specimens, 10 sections of stand for logs and planks, and numerous other small jobs.

DIVISION OF FOREST LANDS AND MAPS

Because of recent legislation regarding public land and the amended procedure resulting from it, the Division of Forest Lands and Maps is in a transition stage. A number of problems must be solved and the only solution in some cases is legislation to give the Director of Forestry less cumbersome means of protecting the forests from unlawful claimants. Other problems have arisen in administrative details which must be settled. Each of these problems will be discussed during the course of the report.

PUBLIC FOREST LANDS CASES

There had been no definite arrangement whereby provincial fiscals were to confer with forest officers before dismissing cases for insufficient evidence to secure a conviction or for other reasons. At the request of the Bureau of Forestry, the Attorney-General on August 23, 1921 issued Circular No. 366, to wit:

To All Provincial Fiscals:

For your information and guidance there is quoted hereunder a letter of the Director of Forestry dated August 12, 1921:

"Sir: In order to avoid complaints presented by Forest Officers to Provincial Fiscals being dismissed by the latter, because of the lack of exact knowledge of the facts involved in the case or because of the lack of mutual understanding between the two officials, I have the honor to request, in cases of violations of the Forest Laws as well as opposition of the Government on behalf of the Director of Forestry against the registration of parcels of public forest land, that the Provincial Fiscals be instructed to communicate or confer with the Forest Officer who detected the violators or who furnished the necessary evidence in support of the Government with a view of discussing the matter thoroughly before dismissing the complaints or withdrawing the opposition of the Government. Also, it is requested that in case the opposition of the Government is withdrawn or a decision is handed down by the Court, the Provincial Fiscal should notify the Director of Forestry to that effect with the least possible delay in order to complete the record of the case in the Bureau of Forestry.

"Very respectfully,

"(Sgd.) ARTHUR F. FISCHER,
"Director of Forestry."

It is requested that the letter above quoted be strictly complied with.

PEDRO TUASON,
Acting Attorney-General.

Great benefit has been derived from this circular because forest officers have been instructed by these conferences with the fiscals and have obtained a better idea as to what constitutes evidence.

The large and unexpected increase in the number of cadastral cases has brought up another problem which has been solved. There was so little time between the date set for the trial of a case and the date upon which notice of the trial was received that forest officers were obliged to enter opposition to the registration of tracts of land, then make the necessary inspection and later withdraw their opposition. This procedure worked a hardship on the court, on the fiscal, and on the landowners. It does not seem possible to get notice of hearings in time to examine the land before the trial and therefore forest officers are being detailed to work with cadastral parties when these are working in forested regions. In other cases maps are obtained from the Bureau of Lands and, if any opposition is to be made, detailed maps are requested.

The following table shows the status and number of cases received and pending during the year 1921:

	Cadastral.			Ordinary.			Total.		
	Cases.	Lots.	Area in ha.	Cases.	Lots.	Area in ha.	Cases.	Lots.[a]	Area in ha.
Pending in 1920	1	365	9,683.1016	24	48	4,468.1019	25	413	14,151.2035
Received in 1921	39	35,790	109,820.6670	894	3,804	41,901.4223	933	39,594	151,722.0893
Total number of cases handled in 1921	40	36,155	119,503.7686	918	3,852	46,369.5242	958	40,007	166,873.2928
Number of cases action unnecessary	21	18,279	27,824.3755	849	3,723	35,082.9243	870	22,002	62,907.2998
Cases acted upon in 1921	19	17,876	91,679.3931	69	129	11,286.5999	88	18,005	102,965.9930
Cases opposition withdrawn after inspection	3	4,292	8,102.5567	32	59	3,523.7572	35	4,351	11,626.3139
Cases in Court	16	13,584	83,576.8364	37	70	7,762.8427	53	13,654	91,339.6791
Cases lost	......	....	....	3 } 6	3 } 11	2,187.9855	6	11	2,187.9855
Cases won[b]	......	....	....	3	8				
Cases pending on January 1st., 1922	16	13,584	83,576.8364	31	59	5,574.8572	47	13,643	89,151.6936

[a] It should be understood that only a part of the area in these lots is forested.

[b] In the three cases won the area of the lots was 2,187 hectares and the area of forest excluded as public forest lands, or as rights-of-way was 256 hectares.

PRIVATE FOREST LANDS REGISTRY

Thirty-seven certificates of forest registration covering 53 parcels of land with a total area of 11,552 hectares, 48 ares and 87 centares have been issued in accordance with the provisions of Section 1829 of the Administrative Code, of which 3,537 hectares, 53 ares and 93 centares are highland forests, 44 hectares, 24 ares and 42 centares mangrove swamps, and 7,970 hectares, 70 ares and 52 centares cultivated and open land.

Claimants of public forest land, who have no right to the land except their assertions and occupancy together with tax receipts, are causing considerable trouble in the administration of the public forests. To these another difficulty has been added, namely, conflicting interpretations of Sections 1513 and 1829 of the Administrative Code.

SEC. 1513. *Charges collectible for wood cut from unregistered private lands.*—The charges above prescribed shall be collected for all wood cut upon any land the title to which is not registered with the Director of Forestry as required by the Forest Law; and in the absence of such registration wood cut and removed from alleged private lands shall be considered as cut and reserved under license from public forests or forest reserves, and shall be subject to the law and regulations in such case applicable.

SEC. 1820. *Words and phrases defined.*—For the purposes of this chapter, "public forest" includes, except as otherwise specially indicated, all unreserved public land, including nipa and mangrove swamps, and all forest reserves of whatever character.

"Forest product," as used in this chapter and in the Internal Revenue Law, includes timber, firewood, barks, tree-tops, resins, gums, wood-oils, beeswax, nipa, rattans, or other forest growth and also stone or earth when taken elsewhere in a forest than from a mining claim.

SEC. 1829. *Registration of title of private forest land.*—Every private owner of forest land shall register his title to the same with the Director of Forestry. A list of such owners, with a statement of the boundaries of their property, shall be furnished by said Director to the Collector of Internal Revenue, and the same shall be supplemented from time to time as occasion may require.

Upon application of the Director of Forestry, the fiscal of the province in which any such land lies shall render assistance in the examination of the title thereof with a view to its registration in the Bureau of Forestry.

A careful study of previous legislation which these sections superseded shows that the purpose of the law was to prevent the fraudulent invoicing of timber. The registration of privately owned forests in the Bureau of Forestry is of distinct benefit to the owner as he is protected in his rights and is enabled to invoice and ship his timber without paying forest charges.

The ambiguity of Section 1513 in referring to any tract of land, the definition given by Section 1820 *for the purposes of the Forest Law* to "public forest" and the general use of the words "forest" (Bosques) and "forest land" (Terrenos Forestales), have been causing such confusion that this Bureau is exerting all its efforts with a view to securing definite and clear legislation on this matter.

The following table shows the private woodlands registered up to December 31, 1921:

Registered private woodlands

Calendar year.	Number of—			
	Parcels.	Hectares.	Ares.	Centares.
1900	420	20,643	68	51
1901	201	68,386	06	95
1902	23	16,412	27	44
1903	3	1,305	94	65
1904	8	29,228	47	82
1905	12	6,631	63	89
1906	21	12,736	95	24
1907	17	28,338	73	05
1908	10	585	97	53
1909	14	6,215	86	62
1910	4	8,658	85	22
1911	5	5,533	67	26
1912	14	6,552	34	89
1913	26	15,229	58	36
1914	16	23,230	05	07
1915	27	13,304	36	95
1916	37	51,663	77	49
1917	48	7,985	68	39
1918	84	43,218	17	26
1919	110	14,943	71	39
1920	41	47,723	82	90
1921	53	11,562	48	87
Total	1,194	440,027	15	75

LAND CLASSIFICATION

Because of the limited personnel and funds both in the Bureau of Lands and in the Bureau of Forestry, it was not practicable in former years to take up land classification on a large scale. However, with the passage of the new land law, it was decided that a radical change must be made. The experience of fifteen years had demonstrated that the inspection of each parcel of land as applied for by settlers was a cumbersome method involving much travel and duplication of work because often two to six applications were filed for the same parcel. This method caused much litigation among rival claimants because no legal boundaries were established.

The Bureau of Forestry therefore withdrew experienced rangers from other work and organized land classification parties. These men were instructed to locate the limits of agricultural land that could be declared open to settlers. Land covered with forests or that was too steep or rocky to plow even though treeless was declared a forest zone for the time being. When the forests have been cut off by timber licensees the land suitable for agriculture can be eliminated from the forest zone. Trees at the corners of the forest zone were blazed and also those on streams or where trails entered the forest in order that the general public might recognize the boundary between forest and agricultural land.

If the Bureau of Lands is able to follow up promptly the classification with a survey of the land then the above procedure is satisfactory. Unfortunately, the Bureau of Lands has so many demands made upon it for surveyors and land surveys of all kinds that the forest zone boundaries may disappear before the survey is made, thus necessitating another examination of the land. To obviate this difficulty and to mark permanently the forest boundary, the Bureau of Forestry should be authorized to survey forest boundaries, place monuments, and then properly establish a forest reserve thus settling the status of the land and making it easier to deal with squatters.

Before going more fully into the subject of forest reserves, the subject of land classification will be finished.

It is expected that the committee appointed by the Honorable, the Secretary of Agriculture and Natural Resources for the purpose of securing greater efficiency, and economy in the coöperative work of the Bureaus of Lands and Forestry for the delimitation and disposition of public lands, will be able to find a method which, if put into practice, will tend to eliminate the actual conflicts between settlers and bring about the proper solution of the questions affecting the disposition and adjudication of public lands.

The most important question at present is to decide the final action to be taken in regard to the thousands of individual applications not yet certified by the Bureau of Forestry. The policy to be adopted will depend upon the available personnel and money.

The table in the appendix shows the distribution of individual applications in the different provinces of the Archipelago, the summary of which is as follows:

Applications on hand during 1921		5,282
Certified for agriculture	305	
Certified for forestry	27	
Returned uncertified	18	
		350
Total pending December 31, 1921		4,932

Table showing the regions under delimitation

Requested.		Regions.		Field work.		Certified on—
By—	Date.	Provinces.	Municipalities.	Begun—	Completed—	
Director of Lands	April 12, '20	Camarines Norte	Labo	May 7, '20	May 25, '20	July 3, '20
Proclamation No. 20	May 25, '20	Mindoro	Bongabon	May 9, '20	June 3, '20	Aug. 25, '20
Director of Lands	May 13, '20	Nueva Ecija	do	July 1, '20	July 16, '20	Aug. 24, '20
Proclamation No. 50	June 11, '20	Mindoro	Calapan	July 2, '20	Sept. 15, '20	Nov. 17, '20
Director of Lands	June 19, '20	Camarines Sur	Tinambac and Calabanga.	Sept. 18, '20	Sept. 30, '20	Dec. 3, '20
		Sorsogon	Irosin	Nov. 17, '20	Nov. 25, '20	May 9, '21
			Capoocan	Oct. 5, '20	Nov. 20, '20	May 12, '21
		Leyte	Alang-alang	Nov. 21, '20	Dec. 23, '20	May 4, '21
			Ormoc	Jan. 3, '21	Jan. 15, '21	June 23, '21
		Samar	Gandara and Borongan.	Oct. 22, '20	Jan. 11, '21	Aug. 11, '21
		Negros Occidental	Kabankalan	July 24, '21	Dec. 22, '21	Report in progress.
Proclamation No. 32	Aug. 27, '20	Lanao	Kolambugan	Nov. 12, '20	Nov. 13, '20	Nov. 19, '20
Director of Lands	Aug. 31, '20	Negros Occidental	San Carlos	Sept. 29, '20	Dec. 15, '20	July 7, '21
Proclamation No. 40		Nueva Ecija	Vaca	Nov. 16, '21	Nov. 27, '21	Pending certification.
Proclamation No. 51	Nov. 19, '20	Tayabas	Guinayangan	Dec. 17, '20	May 19, '21	Oct. 18, '21
			Calauag	do	do	Do.
Proclamation No. 61		Cotabato	Kiamba			
Proclamation No. 63		Mindoro	All			
Proclamation No. 64	April 30, '21	Nueva Vizcaya	All (part only finished).	May 26, '21	July 21, '21	Dec. 28, '21
Proclamation No. 65		Cagayan	All	April 2, '21	Sept. 13, '21	Report in progress.
Proclamation No. 66		Isabela	do	do	do	Do.
Proclamation No. 67		Agusan	do			
		Bukidnon	do			
		Cotabato	do			
		Davao	do			
		Lanao	do			
		Sulu	do			
		Zamboanga	do			
Resolution No. 50, Municipal Council	Aug. 8, '21	Tayabas	Baler	July 8, '21	Dec. 8, '21	Report in progress.

FOREST RESERVES AND ZONES

Forest Station Reserve.—The tract of land where the Forest Station of Port Banga, or barrio Bangaan, municipal District of Banga, Province of Zamboanga, is located, containing an area of 1,533 square meters, was set aside as a reserve on August 27, 1921, by Proclamation No. 28.

Mount Banahao Forest Reserve.—The tract of land comprising mounts Banahao and San Cristobal, having an area of 12,858 hectares, was set aside as a forest reserve on October 14, 1921, by Proclamation No. 42. This reservation was made for reforestation, conservation, and water protection purposes.

Mount Arayat Forest Reserve.—The tract of land comprising the Arayat Mountain, having an area of 4,642 hectares, was set aside as a reserve on October 14, 1921, by Proclamation No. 40. This reservation was made to prevent further violations of the forest regulations, to regulate as much as possible the utilization of forest products in order to insure their constant supply, and to carry out with success the reforestation work to be inaugurated by the Bureau.

Proposed Forest Reserve on the Talavera Watershed (for the protection of the Muñoz Irrigation Project).—The tract covered by this proposed reserve in the municipalities of Lupao, San Jose, Pantabangan, and Caranglan, Province of Nueva Ecija, has already been inspected by the personnel of this Bureau. It has an approximate area of 38,785 hectares.

In connection with the land classification, forest zones were established in the regions already classified in order to separate the lands that are retained by the Bureau of Forestry for forestry purposes.

The necessity of establishing forest reserves becomes apparent when it is realized that under the existing law on practicable way exists of evicting a squatter from a public forest or of preventing him from extending his holdings. In case he is convicted of destroying a forest he considers his receipt for the fine paid as evidence that he has a right to the land. In other cases, persons who apparently have no documents to prove their right to a forest, refuse to submit their evidence of title and also refuse to vacate the land. Legislative action is being considered which will facilitate the protection of forests from such claimants and will also safeguard legitimate private interests in the forests. However, the establishment of forest reserves (permanent forests for beneficial use) will gradually eliminate such claimants but the process is too slow unless more men, especially surveyors, will be available for the work.

COMMUNAL FORESTS

There have been established 95 new parcels with a total area of about 10,322.20 hectares as communal forests in 55 municipalities.

At present, the legal status of communal forests is practically the same as that of an area of public forest. They are set aside for the free use of forest products by a community. There is no other difference, as compared with a public forest granted to licensees, except that no forest charges are paid on the forest products removed.

This legal status of the communal forests makes the public believe them to be, like the public forests, subject to entry or settlement in those parts which are not covered with valuable trees.

The increasing number of conflicts which occur from time to time regarding cases of illegal destruction and occupation of lands within the communal forests and the lack of coöperation in their protection and conservation on the part of the majority of the municipal authorities, caused this Bureau to present a bill to the Legislature to the effect that communal forests be exempted from entry and occupation.

In the development plan of the Bureau of Forestry it is proposed to handle the communal forests in such a way that they will be used for social recreation, a field for silvicultural experiments, and for supplying the present and future forest necessities of the community, in order that the municipality will be independent for its supply of forest products in the future.

This work cannot be carried out with any probability of success as long as the communal forests are not considered practically the same as forest reserves set aside for local use.

The following tables show the total number of communal forests established up to December 31, 1921, and their distribution by provinces:

Communal forests established from 1908 to 1921

Year.	Parcels.	Hectares.
1908	19	5,326.00
1909	19	6,609.00
1910	19	5,796.00
1911	53	15,147.00
1912	59	10,957.00
1913	26	8,387.00
1914	45	6,860.00
1915	90	12,129.00
1916	110	15,862.00
1917	83	10,110.00
1918	61	7,704.82
1919	68	10,587.85
1920	69	9,008.85
1921	95	10,322.20
Total	811	129,776.82

Statement of communal forests established up to December, 1921

Provinces.	Parcels. established.		Total parcels established up to 1921.	Municipalities, rancherias or townships.			Cancelled.	
	Before 1921.	During 1921.		With communal forests.	Without communal forests.	Area in hectares of parcels established up to 1921.	Parcels.	Hectares.
Abra	27	2	29	16	23	5,723.00	.....	.....
Albay–Catanduanes	16	7	23	12	11	2,105.00	.....	.....
Antique	4	1	5	5	8	1,070.00	.....	.....
Bataan	16	.....	16	12	.....	4,791.40	2	464.00
Batanes	.....	.....	.....	.....	6	.....	.....	.....
Batangas	2	.....	2	1	24	136.00	.....	.....
Bohol	33	5	38	25	11	4,660.80	.....	.....
Bulacan	2	.....	2	2	22	340.16	1	232.16
Cagayan	37	2	39	20	4	4,625.60	2	186.00
Camarines Norte	8	.....	8	7	2	1,171.00	.....	.....
Camarines Sur	34	9	43	25	6	4,702.90	1	175.00
Capiz	30	2	32	11	14	3,026.00	.....	.....
Cavite	.....	1	1	1	19	252.00	.....	.....
Cebu	10	2	12	9	42	1,288.80	.....	.....
Ilocos Norte	22	.....	22	15	15	7,269.00	4	1,127.00
Ilocos Sur	27	.....	27	23	35	9,508.00	.....	.....
Iloilo	14	.....	14	7	28	1,817.00	.....	.....
Isabela	19	.....	19	13	14	3,131.00	1	106.00
Laguna	18	8	16	11	17	2,252.00	.....	.....
La Union	15	1	16	19	14	4,820.00	.....	.....
Leyte	42	9	51	25	21	5,508.28	.....	.....
Mindoro	4	7	11	5	14	1,176.00	.....	.....
Misamis	21	.....	21	13	42	3,383.00	.....	.....
Mindanao and Sulu:								
Agusan	1	.....	1	1	57	160.00	.....	.....
Bukidnon	1	.....	1	1	11	620.00	.....	.....
Cotabato	.....	.....	.....	.....	32	.....	.....	.....
Davao	2	.....	2	1	22	164.00	.....	.....
Lanao	2	1	3	2	36	1,053.00	2	800.00
Sulu	.....	.....	.....	.....	29	.....	.....	.....
Zamboanga	4	.....	4	2	76	327.00	1	9.00
Mountain Province:								
Apayao	4	.....	4	1	6	606.00	.....	.....
Benguet	1	.....	1	1	11	100.00	.....	.....
Bontoc	.....	.....	.....	.....	18	.....	.....	.....
Ifugao	.....	.....	.....	.....	6	.....	.....	.....
Kalinga	.....	.....	.....	.....	13	.....	.....	.....
Nueva Ecija	27	2	29	23	35	5,867.00	1	195.00
Nueva Vizcaya	5	5	10	6	12	1,467.00	.....	.....
Occidental Negros	32	.....	32	14	11	3,633.00	1	240.00
Oriental Negros	16	.....	16	13	35	1,596.00	.....	.....
Palawan	.....	.....	.....	.....	16	.....	.....	.....
Pampanga	8	.....	8	3	18	395.00	.....	.....
Pangasinan	42	7	49	30	34	13,448.48	1	300.00
Rizal	6	8	14	7	20	1,400.40	1	76.00
Romblon	6	.....	6	4	5	485.00	.....	.....
Samar	51	8	59	33	12	3,908.00	.....	.....
Sorsogon–Masbate	21	8	29	16	8	2,554.00	.....	.....
Surigao	15	.....	15	8	23	2,884.00	.....	.....
Tarlac	10	1	11	8	8	1,894.00	1	265.00
Tayabas	44	1	45	21	7	4,569.00	1	126.00
Marinduque	10	.....	10	5	1	1,432.00	.....	.....
Zambales	17	3	20	13	.....	3,972.00	.....	.....
Total	716	95	811	490	1,004	129,776.82	20	4,301.16

Total number of parcels and hectares established from 1908 to 1921	811	129,776.82
Total number of parcels and hectares cancelled in various years	20	4,301.16
Balance in force	791	125,475.66

MAPPING AND DRAFTING

For the purpose of compiling an up-to-date forest map of the different regions in the Philippines, forest officers are required to take topographical notes and valuation surveys in addition to their numerous work relating to the administration of public forests. During the year 1921, the total of the trail notes taken is 13,087.95 kilometers with 1,137.74 hectares of forest valuation distributed in the different districts as follows:

Number of kilometers of field notes and number of hectares of valuation surveys taken during 1921

District No.	Received.		Pending.		Total.	
	Kilometers.	*Hectares.*	*Kilometers.*	*Hectares.*	*Kilometers.*	*Hectares.*
1	315.99	2.50	5,194.45	249.21	5,510.44	251.71
2	147.66	8.50	56.62	0	204.28	8.50
3	122.25	8.00	59.97	0	182.22	8.00
4	805.90	118.23	375.19	4.40	1,181.09	122.63
5	491.22	129.85	536.78	38.61	1,028.00	168.46
6	725.79	88.98	283.02	9.00	1,008.81	97.98
7	301.65	77.48	898.57	14.50	1,200.22	91.94
8	378.75	41.94	192.47	40.50	571.22	82.48
9	114.27	0	6.00	0	120.27	0
10	257.48	42.90	210.46	36.68	467.89	79.58
11	168.50	43.62	47.48	11.75	215.98	55.37
12	99.72	29.58	21.50	4.60	121.22	34.18
13	505.05	29.90	771.26	107.06	1,276.31	136.96
Total	4,434.18	621.43	8,653.77	516.31	13,087.95	1,137.74

In order to unify the compilation of all topographical and forest data which are gathered from different sources, the Philippine Archipelago is divided into progressive forest sheets of 1° x 30′ for those compilations on the scale of 1:100,000 and 10′ x 10′ for those having a scale of 1:20,000. The scale of 1:100,000 is used for the general compilation of all the data and it serves as the basis for the preparation of the forest Atlas of the Philippines. The scale of 1:20,000 is used in the compilation of all data about concessions, communal forests, studies for exploitation, and in all cases when the showing of details or graphical information is necessary. From these sheets other maps are traced or prepared.

	Sheets.
Progressive forest maps:	
Scale 1:100,000—1° × 30′ = 45 inches × 25 inches	162
On drawing paper:	
Pending preparation on December 31, 1920	34
Prepared during 1921	5
Pending preparation	29
On tracing cloth:	
Pending on December 31, 1921	110
Scale 1:20,000—10′ × 10′ = 38 inches × 38 inches	1,481
Pending December 31, 1921	1,451
Special maps:	
Communal forest:	
Pending on December 31, 1920	11
Received during 1921	95
Total	106
Completed during 1921	89
Pending on December 31, 1921	17

Special maps—Continued.	
Land classification:	Sheets.
Received during 1921	11
Completed during 1921	9
Pending	2
Others completed during 1921:	
Forest reserves	4
Forest reconnaissance	1
Forest contract of leases or special permits	4
For opposition against the registration in the Court	156
Showing vegetation in color	19
Copies in blue and maduro prints for field force and official uses	3,377
Sold to different entities (₱133.47)	66
Miscellaneous	284

ADMINISTRATIVE DIVISION

GENERAL STATEMENT

The work of this Division involves the general supervision of all the clerical work of the Bureau, keeping of the efficiency and civil records of the employees and all general records, the preparation of estimates for the annual appropriation and distribution of same and its accounting, the care of the property, the control of the clerks in the provinces, the upkeep and maintenance of the office building, the supervision of the general section and the general administration of the Office including the preparation of routine correspondence and typing reports appertaining to other divisions.

This Division has a direct relation with the increase in technical and quasi-technical personnel and activities of this Bureau and due to the economy measure which has been strictly observed in this office, the personnel in the various sections under this Division has been overworked and the undersigned wishes to state in this connection that it is earnestly desired that as soon as it is possible, due recognition be given to the personnel of this Division as well as to all the clerks in this Bureau, in general, by increasisng its remuneration and number, as any increase in the activities of this Bureau has a direct bearing on its clerical force. The present salaries paid to the clerks in this Bureau do not offer much incentive for advancement and therefore clerks consider the work in the Bureau only as a stepping stone for transfer to other Bureaus of the Government.

This Division has under its control the following sections besides having direct supervision over all clerical work of the Bureau: Accounting, Property, Records, Library and Translating, General Service Sections, and District Clerks.

ACCOUNTING SECTION

This section has under its charge the auditing of all expense accounts of the personnel and all such accounts as are rendered by or against this Bureau as well as the preparation of all warrants in payment of salaries and all accounts with its employees and other parties.

Due to economy measure this section has been kept down to a minimum of personnel that its clerks are overburdened. If additional field personnel is allowed the coming year it is imperative that the necessary addition be allowed for clerks in this section.

PROPERTY SECTION

This section has under its charge the supervision of all property work and its distribution to different requisitioners in this Bureau. The requisitions of the Forest Stations and field force and the central office of this Bureau have been reduced to the minimum to carry on the routinary office and field work.

Foreseeing that the amount allotted for 1921, would not entirely cover the needs under this item, only supplies of absolute necessity were requisitioned during the year, but at the end of the year, this amount allotted for this item was exceeded. The excess was due to the fact that the graduates of the Forest School who were employed during the year had to be provided with office and field equipment. Additional money was requested in the estimates but not allowed in 1921 Budget, and in addition the Emergency Board reduced the amount allowed.

During the year, however, a quantity of equipment and supplies was transferred to this Bureau without cost, but before this could be used it had to be repaired and in instances it had caused delay. Property amounting to about ₱2,795.26 was dropped from the records of this office during the year through sale, loss, and condemnation. The adjustments have been sanctioned by the Insular Auditor.

The property clerk, who is the chief of this section also acts as the cashier and disbursing officer for the payment of salaries of the employees of the Manila Office and receives cash bond deposits required of all licensees of this Bureau. His average monthly collections amounted to ₱14,000 during the time of the renewal of all timber and minor forest product licenses. All such collections as are made by him on this account are deposited in the Insular Treasury every other day in compliance with existing regulations.

RECORD SECTION

Due to the low salary paid to the clerks of this Bureau as has been stated, only mediocre clerks could be obtained for this section, but the older and more experienced members of this section have tried their best to carry on the work and to take upon themselves the increased work which naturally results through the increase in the technical and quasi-technical force. In June of this year, the work of this section has been reorganized and some changes in personnel have taken place, and the handling of records has been divided among the more experienced clerks in this section in order to divide evenly the work and to properly safeguard the records of this Bureau.

The system in use in this section is similar to the system used in the United States Forest Service, designating the correspondence written by and received in this Bureau, and is briefed on cards which are arranged alphabetically according to their heading in order to readily locate any individual piece of correspondence.

LIBRARY AND TRANSLATING SECTION

All the books, periodicals, lumber journals and other magazine and publications received in this Bureau are under the charge of this section. Since the chief of this section also does the translation work of this Office, it is desired that a clerk be assigned to this section as his assistant as soon as possible.

GENERAL SERVICE SECTION

The chauffeur, messengers, janitors, and watchmen come under this section. While the work in this section has been carried on satisfactorily throughout the year, both in the messenger service and in the maintenance and upkeep of the building and yards of this Bureau, it is desired, however, that funds be made available for the appointment of additional messengers as their present number is by no means sufficient to answer the demand for messenger service of this office.

DISTRICT CLERKS

The difficulty of securing clerks for the district stations of this Bureau has continued during the year. The efforts exerted by this office to secure efficient clerks for its district stations have in many instances produced no results because of the low salary, which this Bureau is authorized to pay them. In some instances temporary clerks have been appointed and in other cases forest officers have been obliged to do the clerical work of their station at a sacrifice of their field work. Until higher pay can be offered for these positions this condition will continue.

RECOMMENDATIONS

That the policy of permanent forest reserves be given greater impetus;

That the legislation affecting communal forests be changed to give them the status of forest reserves;

That forest legislation now in force be made clearer and delegating authority of enforcement on the Director of Forestry;

That at least six forest experiment stations be established throughout the Islands;

That a forest products laboratory be provided for the Division of Investigation;

That funds be made available for adequate reforestation of water sheds;

That the Government urge the necessity of higher technical training in forestry at the Forest School to the Board of Regents of the University;

That the salaries of the personnel of the Bureau be on the same plane as other technical bureaus;

That the personnel, particularly in the ranger group, be increased to adequately handle the work; and

That a permanent corps of forest guards on at least third grade Civil Service rating be allowed.

Respectfully submitted,

Arthur F. Fischer

Director of Forestry.

The SECRETARY OF AGRICULTURE
AND NATURAL RESOURCES,
Manila.

DIRECTORY OF THE BUREAU OF FORESTRY

ARTHUR F. FISCHER, *Director*

DIVISION OF FOREST MANAGEMENT[1]

Ramon J. Alvarez	Forester, Acting Chief.
Apolinario Suyat	Forest supervisor
Agapito Cenabre	Forest supervisor.
Fausto Alambra	Ranger.
Petronilo Cortes	Ranger.
Jose G. Pacis	Ranger.
Gregorio Elumir	Ranger.
Jose Angeles	Junior stenographer.

SPECIAL PERMIT SECTION

Eladio C. Leaño	Forest supervisor, Chief.
Alejandro de Mesa	Ranger.
Fausto Pe Benito	Clerk.

LICENSE SECTION

Eufemio Santillan	Chief.
Enrique Baña	Clerk.
Luis S. Mabagos	Clerk.
Avelino Rivera	Clerk.
Anselmo Racpan	Clerk.
Agustin Guzman	Clerk.
Francisco de Asis	Clerk.
Melanio Espiritu	Clerk.
Manuel Bollozos	Clerk.
Claro L. Camba	Clerk.
Laureano de la Peña	Clerk.
Eduardo Rosete	Clerk.

DISTRICT NO. 1

[Provinces: Cagayan, Isabela, Mountain Province, (Apayao and Kalinga, Sub-provinces of), and Batanes]

Forest Station at Aparri, Cagayan (district headquarters):	
Pastor de la Peña	Officer in charge.
Angel Salazar	Ranger.
Felipe Pattugalan	Clerk.
Forest Station at Ilagan, Isabela:	
Mamerto Azurin	Officer in charge.
Forest Station at Alcala, Cagayan:	
Deogracias Guzman	Officer in charge.
Francisco Siriban	Ranger.
Forest Station at Echague, Isabela:	
Vicente Velasco	Officer in charge.
Forest Station at Claveria, Cagayan:	
Luis Aguilar	Officer in charge.

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[1] All scalers under this division also belong to the Division of Sawmills and Utilization.

DISTRICT NO. 2

[Provinces: Ilocos Norte, Ilocos Sur, and Abra]

Forest station at Vigan, Ilocos Sur (district headquarters):

Espiritu Paraiso	Officer in charge.

Bangued, Abra:

Cayetano Barros	Officer in charge.
Juan Balbuena	Forest guard.

DISTRICT NO. 3

[Provinces: Mountain Province (Benguet, Bontoc, Amburayan, and Lepanto), and La Union (northern part)]

Forest Station at Baguio, Mountain Province (district headquarters):

Mauricio J. Oteyza	District forester.
Vicente J. Defensor	Ranger.
Edilberto Madrid	Ranger.
Jose Medina	Ranger.
Pastor Garcia	Forest guard.
Esteban Fontanilla	Forest guard.
Pedro Gacad	Forest guard.
Aquilino Balbin	Forest guard.
Timoteo Lagasca	Forest guard.
Luis Chigas	Forest guard.

DISTRICT NO 4

[Provinces: Pangasinan, Nueva Ecija, Nueva Vizcaya, Tarlac, and La Union (southern part)]

Forest Station at Dagupan, Pangasinan (district headquarters):

Benigno Alejandro	Officer in charge.
Juan Acenas	Ranger.
Irineo Lopez	Clerk.
Canuto Ducusin	Forest guard.

Forest Station at San Quintin, Pangasinan:

Amando Curaming	Officer in charge.
Victoriano Mariano	Forest guard.
Anselmo Agustin	Forest guard.

Forest Station at Bayombong, Nueva Vizcaya:

Pedro Afalla	Officer in charge.

DISTRICT NO. 5

[Provinces: Batangas, Tayabas, Laguna, and Marinduque]

Forest Station at Los Baños, Laguna:

Theodore C. Zschokke	District forester.
Severo Oliveros	Ranger.
Mamerto D. Sulit	Ranger.
Ildefonso C. Ferrer	Forest guard.
Cirilo Cabauatan	Forest guard.
Isabelo H. Alviar	Forest guard.

Forest Station at Calauag, Tayabas:

Braulio Cristobal	Officer in charge.
Felix Dayao	Forest guard.
Albino Labaco	Forest guard.

Forest Station at Infanta, Tayabas:

Mauro S. Baculi	Officer in charge.

Forest Station at Laguimanoc, Tayabas:

Pedro P. Lasquety	Officer in charge.
Victor Gaboco	Forest guard.
Eusebio Villanueva	Forest guard.

Forest Station at Mauban, Tayabas:

Norberto Soloria	Officer in charge.
Angel A. Sarmiento	Forest guard.

Forest Station at Kabibihan, Tayabas:

Gregorio Arizabal	Officer in charge.
Castor Jundak	Forest guard.
Cayetano Gamalinda	Forest guard.

DISTRICT No. 6

[Provinces: Albay, Camarines Sur, Camarines Norte, Catanduanes, and Sorsogon]

Forest Station at Naga, Camarines Sur (district headquarters):

Macario A. Mariano	Officer in charge.
Gregorio J. Labitag	Ranger.
Inocencio Ramirez	Ranger.
Gregorio Miras	Ranger.
Fermin Sol	Forest guard.
Eulogio Gines	Forest guard.

Forest Station at Mercedes, Camarines Norte:

Jesus O. Duran	Officer in charge.
Pedro Magistrado	Forest guard.

Forest Station at Sorsogon, Sorsogon:

Numeriano Valencia	Officer in charge.
Alejandro Eguarras	Forest guard.

Forest Station at Catabangan, Tayabas:

Macario Simeon	Officer in charge.
Pedro Silvestre	Forest guard.
Vedasto Rafa	Forest guard.

Forest Station at Virac, Albay:

Felix Mabbayag	Officer in charge.
Agapito M. Borja	Forest guard.

Forest Station at Legaspi, Albay:

Filemon Kapuno	Officer in charge.
Hermenegildo Bautista	Ranger.

DISTRICT No. 7

[Provinces: Antique, Capiz, Iloilo, Negros Occidental, and Romblon]

Forest Station at Iloilo, Iloilo (district headquarters):

Jose B. Hirro	Officer in charge.
Jose B. Logan	Ranger.
Maximino Rondario	Ranger.
Pedro Valentin	Ranger.
Manuel Tupas	Ranger.
Gavino Jarantilla	Forest guard.

Forest Station at Cadiz, Negros Occidental:

Roman Amor	Officer in charge.
Gregorio Poblacion	Ranger.
Teodoro Oliveros	Forest guard.
Leon de los Reyes	Forest guard.
Mansueto Olaira	Forest guard.

Forest Station at San Carlos, Negros Occidental:

Melecio Lopez	Officer in charge.
Fausto Ejercito	Forest guard.

Forest Station at Ilog, Negros Occidental:

Vicente Villaflor	Officer in charge.
Inocencio Debuyan	Forest guard.
Julian Catipay	Forest guard.

Forest Station at Fabrica, Negros Occidental:

Juan S. Versoza	Officer in charge.
Pedro Montero	Ranger.
Ruperto Yzarri	Forest guard.
Francisco Diaz	Forest guard.
Severino E. Lovero	Forest guard.
Ambrosio Canilao	Forest guard.

Forest Station at New Washington, Capiz:

Probo Villanueva	Officer in charge.
Epifanio Biñas	Forest guard.

DISTRICT No. 8

[Provinces: Zamboanga (except northern part), Sulu, Cotabato, and Davao]

Forest Station at Zamboanga, Zamboanga (district headquarters):

Porfirio San Buenaventura	Acting district forester.
Florencio Asiddao	Ranger.
Celestino Gomez	Ranger.
Sixto Babao	Ranger.
Pedro Aguilar	Forest guard.

Forest Station at Cotabato, Cotabato:

Jose Flores	Officer in charge.
Cayetano Macaraeg	Ranger.

Forest Station at Isabela de Basilan, Zamboanga:

Teodoro Tecson	Officer in charge.
Isabelo V. Ostrea	Forest guard.

Forest Station at Naga-Naga, Zamboanga:

Enrique Alviar	Officer in charge.
Gregorio L. Dagang	Ranger.
Jose Makil	Ranger.
Nicolas O. Luna	Forest guard.

Forest Station at Port Banga, Zamboanga:

Santiago Babaran	Officer in charge.

Forest Station at Davao, Davao:

Simplicio Aguilar	Officer in charge.
Ramon Mataya	Ranger.
Lorenzo Logan	Ranger.

Forest Station at Mati, Davao:

Juan C. Andrada	Officer in charge.

Forest Station at Jolo, Sulu:

Juan Corales	Officer in charge.

Forest Station at Margosatubig, Zamboanga:

Juan Daproza	Officer in charge.
Bonifacio Perez	Ranger.
Manuel San Luis	Forest guard.

DISTRICT No. 9

[Province: Palawan]

Forest Station at Puerto Princesa, Palawan (district headquarters):

Miguel Pato	Officer in charge.
Benito L. Roque	Ranger.

Forest Station at Balabac, Palawan:

Mauro Iblaza	Officer in charge.

DISTRICT No. 10

[Provinces: Leyte (eastern half), Samar, Surigao, and Masbate]

Forest Station at Tacloban, Leyte (district headquarters):

Adriano V. Santos	Officer in charge.
Leon Rojas	Ranger.
Agustin P. Angeles	Ranger.
Florentino L. Nerviol	Forest guard.
Jose Sydiongco	Forest guard.
Tereso Malate	Forest guard.

Forest Station at Catbalogan, Samar:

Ramon A. Acuña	Officer in charge.

Forest Station at Laoang, Samar:

Emeterio Edmilao	Officer in charge.

Forest Station at Masbate, Masbate:

Atanasio Catambay	Officer in charge.
Florentino Verzoza	Ranger.

Forest Station at Surigao, Surigao:

Perfecto Tomeldan	Officer in charge.
Simon Montero	Ranger.

DISTRICT No. 11

[Provinces: Cavite, Rizal, Pampanga, Bataan, Bulacan, and Zambales]

Forest Station at Manila (district headquarters):

Clemente Mariano	Officer in charge.
Vicente Zosa	Ranger.
Eugenio Mendoza	Clerk.
Teodoro Magalindan	Forest guard.

Forest Station at Arayat, Pampanga:

Ambrosio Galisim	Officer in charge.

Forest Station at Orani, Bataan:

Pedro Gangan	Officer in charge.
Victorio Alquiroz	Forest guard.
Arcadio Nava	Forest guard.

Forest Station at Limay, Bataan:

Tomas N. Roque	Officer in charge.
Florencio M. Songco	Ranger.
Felix Bawan	Ranger.
Primitivo Baluyot	Forest guard.
Deogracias F. Agustin	Forest guard.
Emilio Fabila	Forest guard.

Forest Station at Moron, Bataan:

Fernando L. Amarillas	Officer in charge.

Forest Station at Norzagaray, Bulacan:

Andres Bernardo	Officer in charge.

Forest Station at Masinloc, Zambales:

Valentin Sajor	Officer in charge.
Valeriano V. Elgincolin	Forest guard.

DISTRICT No. 12

[Province: Mindoro]

Forest Station at Calapan, Mindoro (district headquarters):

Cornelio Nable Jose	Officer in charge.
Aniano David	Ranger.
Eusebio Leuterio	Ranger.

Forest Station at San Jose, Mindoro:

Leoncio Rebong	Officer in charge.

DISTRICT No. 13

[Provinces: Cebu, Negros Oriental, Misamis, Bukidnon, Lanao, Agusan, Leyte (western half) and Bohol]

Forest Station at Cebu, Cebu (district headquarters):

Isabelo Achacoso	Officer in charge.
Silvino Reyes	Ranger.
Leonor Lizardo	Ranger.
Daniel B. Allas	Ranger.
Victoriano Caratao	Forest guard.

Forest Station at Dumaguete, Negros Oriental:

Alberto Villanueva	Officer in charge.
Venancio N. Fernandez	Forest guard.

Forest Station at Butuan, Agusan:

Angel Mallonga	Officer in charge.
Rufo Burnea	Forest guard.

Forest Station at Kolambugan, Lanao:

Bernardo Tocmo	Officer in charge.
Lucio Abalos	Ranger.
Pedro C. Carro	Forest guard.
Guillermo Luñgay	Forest guard.

Forest Station at Dipolog, Zamboanga:

Manuel Malana	Officer in charge.

Forest Station at Cagayan, Misamis:

Timoteo Quimpo	Officer in charge.

DIVISION OF FOREST LANDS AND MAPS

Rafael Medina	Forester, Chief.
Doroteo Soriano	Forest supervisor, Assistant to the chief.
Cecilio Maneja	Forest supervisor.
Severo S. Ponce	Forest supervisor.
Vicente Castillo	Ranger.
Aquilino Contreras	Ranger.
Crispino Tansioco	Ranger.
Julio Baldemor	Ranger.
Eugenio de la Cruz	Ranger.
Vicente Caguioa	Ranger.

Leoncio de la Cruz	Ranger.
Pedro Aduviso	Ranger.
Vicente Parras	Ranger.
Gervasio Rarang	Ranger.
Juan Oblina	Ranger.
Magdaleno Tugade	Ranger.
Juan Fontanoza	Ranger.
Celso Medrano	Ranger.
Antonio Quiaoit	Ranger.
Gregorio Zamuco	Ranger.
Leonardo F. Granada	Ranger.
Rafael San Pedro	Ranger.
Felix Mabbayag	Ranger.
Ambrosio Damo	Ranger.
Jose B. Logan	Ranger.
Hilario Borromeo	Forest guard.
Cornelio Samaniego	Draftsman.
Gregorio Vicencio	Draftsman.
Hermogenes Reyes	Draftsman.
Cecilio de la Cruz	Draftsman.
Sebastian Domingo	Draftsman.
Marcelino Cruz	Draftsman.
Cayetano Crisostomo	Draftsman.
Angel Reyes	Draftsman.
Wenceslao Moje	Draftsman.
Alberto Gutierrez	Draftsman.
Luis Angeles	Draftsman.
Juan Acojido	Clerk.
Eligio Cordero	Clerk.
Conrado Tongco	Clerk.
Edilberto Barot	Clerk.

DIVISION OF INVESTIGATION, LOS BAÑOS, LAGUNA

Otto W. Pflueger	Forester, Chief.
Theodore C. Zschokke	Forester.
August P. West	Technical employee.
Harold C. Cuzner	Technical employee.
Antonio P. Racelis	Forester.
Placido Dacanay	Forester.
Carlos Sulit	Ranger.
Jose F. Nano	Ranger.
Maximo Oro	Ranger.
Francisco Rola	Ranger.
Pioquinto de la Vega	Ranger.
Felipe Salvoza	Ranger.
Justino Esguerra	Ranger.
Nicolas Angeles	Nurseryman.
Florentino Canicosa	Nurseryman.
Domingo Ilag	Nurseryman.
Maximo Pañga	Nurseryman.
Julian Rebelleza	Nurseryman.
Severino Casimiro	Nurseryman.

DIVISION OF SAWMILLS AND UTILIZATION[1]

William Crosby	Forester, Chief.
Luis J. Reyes	Forester.
Justo M. Pascual	Ranger.
Alberto Barros	Ranger.
Fortunato Manuel	Ranger.
Pablo Roque	Forest guard.
Sinforoso Apacible	Forest guard.
Doroteo Abella	Clerk.
Aurelio Maglunog	Clerk.
Andres G. Ferrer	Clerk.

ADMINISTRATIVE DIVISION

Vicente C. Ramos	Chief clerk.
Dominador G. Castro	Senior stenographer.
Aurea Villaruz (Miss)	Junior stenographer.

ACCOUNTING SECTION

Eugenio Tadle	Chief.
Melchor Enriquez	Clerk.
Aguedo Castro	Clerk.
Deogracias Antonio	Clerk.
Arcadio Gepiga	Clerk.
Patricio Ortega	Clerk.
Miguel Laguitao	Clerk.
Felipe Reyes	Clerk.

PROPERTY SECTION

Cirilo Asperilla	Property clerk, Cashier and Disbursing officer.
Pablo D. Villena	Clerk.
Venancio Babida	Clerk.
Santiago Laya	Clerk.
Victorino Narcelles	Clerk.
Agapito Arada	Clerk.
Francisco Sonto	Clerk.
Demetrio Saluñga	Clerk.

RECORD SECTION

Sulpicio Olimpo	Chief.
Aquilino Bartolome	Clerk.
Laureano Navasca	Clerk.
Agustin Cardines	Clerk.
Jose Salvador	Clerk.
Juan G. Loteyro	Clerk.
Angel Cosca	Clerk.

LIBRARY AND STATISTICAL SECTION

Simplicio Beltran	Chief.

GENERAL SERVICE SECTION

Gabino Cubos	Chauffeur.
Mauro Linchanco	Messenger.
Balbino B. Nanong	Messenger.

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[1] All scalers under Division of Forest Management are also under this division.

Francisco Balderosa	Messenger.
Bartolome Estacio	Porter.
Severino Esguerra	Watchman.
Manuel Perez	Watchman.
Fernando Rañada	Janitor.
Benito Zambales	Janitor.
Pastor Ramos	Janitor.
Victoriano Dizon	Janitor.
Agustin Lagan	Janitor.

APPENDIX

STATISTICAL TABLES

TABLE NO. 1.—*Statement of the public lands applications received from the Bureau of Lands and of the certification made to the same regarding the agricultural or forest value*

Province.	Received from the Bureau of Lands.									Certification made to the Bureau of Lands.			
	Pending from previous year.				During the year 1921.				Total.	Agriculture.			
	A. C.	H.	P.	L.	A. C.	H.	P.	L.		A. C.	H.	P.	L.
Abra		2	2						4				
Agusan		49	1	3		102	10	6	171			1	
Albay		57	8			21	1		87				
Antique		1				1			2				
Bataan		30	11	4		1			46			1	
Batanes		1							1				
Batangas													
Bohol		12		2	56				70	56	1		
Bukidnon		1		1		23	1	4	30				
Bulacan		3							3				
Cagayan		36	1			116	13		166				
Camarines Norte		73	8			10			91		7	2	
Camarines Sur		87	12	4		12			115			4	2
Capiz		19	1						20				
Cavite													
Cebu		10	2	3		1			16				
Cotabato		229	8	16		236	7	17	513		37		1
Davao		164	7	27		90	10	34	332		10	1	2
Ilocos Norte		2	3						5			2	
Ilocos Sur		20	1						21		1	1	
Iloilo		2	2						4				
Isabela		59	7			375	18	8	467				
Laguna		11							11		1		
Lanao		28	2	1		76	10	9	126		2	1	1
La Union		20		1			2		23		4		
Leyte		149	5						154		18	4	
Marinduque				1					1				
Masbate		23	4	1		4			32				
Mindoro		211	9			241	12	7	480		16		1
Misamis		7				3	1		11				
Mountain Province		19	1			6	2		28				
Nueva Ecija		133	29	4		183		17	366		11	7	1
Nueva Vizcaya		34	7			274	9	30	354		14		1
Occidental Negros		35		3		25		2	65		7		1
Oriental Negros		6				2			8				
Palawan		39	6			18			63				

Pampanga		14	1	1					16		1		1
Pangasinan		58	1	2		16	4		81		33	3	2
Rizal		3		1					4		1		
Romblon		13	3			1			17		1	1	
Samar		31	1				1		33		2		
Sorsogon		37	1			7			45		1		
Sulu				1		2		1	4				
Surigao		20	1						21		8		
Tarlac		55	3						58				
Tayabas		647	45	3		58	7		760		25	8	
Zambales		32	4	8		22	1	1	68		1		
Zamboanga		73	2	1		170	21	22	289		6	2	
Total		2,555	199	88	56	2,096	130	158	5,282	56	208	38	13

Province.	Certification made to the Bureau of Lands.					Returned to the Bureau of Lands, uncertified during the year 1921.				Total pending for inspection, December 31, 1921.				
	Forestry.				Total.									
	A. C.	H.	P.	L.		H.	P.	L.	Total.	A. C.	H.	P.	L.	Total.
Abra											2	2		4
Agusan					1						151	10	9	170
Albay		3			3	2			2		73	9		82
Antique											2			2
Bataan					1						31	10	4	45
Batanes											1			1
Batangas														
Bohol					57						11		2	13
Bukidnon											24	1	5	30
Bulacan											3			3
Cagayan											152	14		166
Camarines Norte					9						76	6		82
Camarines Sur					6						99	8	2	109
Capiz											19	1		20
Cavite														
Cebu											11	2	3	16
Cotabato					38						428	15	32	475
Davao					13	3		5	8		241	16	54	311
Ilocos Norte					2						2	1		3
Ilocos Sur					2						19			19
Iloilo											2	2		4
Isabela											434	25	8	467
Laguna					1						10			10
Lanao		1			5						101	11	9	121
La Union					4						16	2	1	19
Leyte					22						131	1		132

NOTE.—A. C. = Agricultural Colony of 16 hectares lot; H. = Homestead; P. = Purchase; L. = Lease.

TABLE NO. 1.—*Statement of the public lands applications received from the Bureau of Lands and of the certification made to the same regarding the agricultural or forest value*—Continued

Province.	Certification made to the Bureau of Lands.					Returned to the Bureau of Lands, uncertified during the year 1921.				Total pending for inspection, December 31, 1921.				
	Forestry.				Total.									
	A. C.	H.	P.	L.		H.	P.	L.	Total.	Total.	H.	P.	L.	Total.
Marinduque													1	1
Masbate											27	4	1	32
Mindoro					17	1	1		2		455	20	6	461
Misamis						3			3		7	1		8
Mountain Province											25	3		28
Nueva Ecija					19						305	22	20	347
Nueva Vizcaya					15						294	16	29	339
Occidental Negros		1			1						7			7
Oriental Negros				2	10						53		2	55
Palawan											57	6		63
Pamapanga					2						13	1		14
Pangasinan		5			43						36	2		38
Rizal					1						2		1	3
Romblon					2						13	2		15
Samar					2						29	2		31
Sorsogon		1			2						42	1		43
Sulu											2		2	4
Surigao					3						17	1		18
Tarlac		2			2						53	3		56
Tayabas		9			37	1	2		3		670	47	3	720
Zambales		1			2						52	5	9	66
Zamboanga		2			10						235	21	23	279
Total		25		2	332	10	3	5	18		4,413	293	226	4,932

NOTE.—A. C. = Agricultural Colony of 16 hectares lot; H. = Homestead; P. = Purchase; L. = Lease.

Fiscal year.	Agricultural colonies.			Homesteads.			Sales.			Leases.			Grand total.
	Agriculture.	Forest.	Total.	Agriculture.	Forest.	Total.	Agriculture.	Forest.	Total.	Agriculture.	Forest.	Total.	
1905				80	6	86	8		8				94
1906				318	16	334	20	1	21	1		1	356
1907				881	19	900	23		23	12		12	935
1908				2,456	51	2,507	49	1	50	26		26	2,583
1909				1,523	187	1,710	26	3	29	27		27	1,766
1910				1,175	385	1,560	34	5	39	42	2	44	1,643
1911				1,528	221	1,749	46	3	49	30	1	31	1,829
1912				2,609	301	2,910	95	11	106	47	1	48	3,064
1913				2,680	269	2,949	104	30	134	47	1	48	3,131
1913 (July 1 to December 31)				1,653	159	1,812	81	16	97	41	3	44	1,953
1914				4,812	685	5,497	279	36	315	77	1	78	5,890
1915	1,086	28	1,114	5,965	688	6,653	317	52	369	70	1	71	8,207
1916	934	41	975	6,015	670	6,685	227	18	245	55	4	59	7,964
1917	670		670	7,632	797	8,429	457	27	484	118	6	124	9,707
1918	41		41	5,605	621	6,226	420	33	453	109	16	125	6,845
1919				5,256	790	6,046	431	51	482	137	22	159	6,687
1920				2,061	403	2,464	225	23	248	70	10	80	2,792
1921	56		56	203	25	228	33		33	13	2	15	332
Total	2,787	69	2,856	52,452	6,293	58,745	2,875	310	3,185	922	70	992	65,778

SUMMARY

Applications on hand during 1921		5,282
Certified for agriculture	305	
Certified for forestry	27	
Returned uncertified	18	350
Total pending December 31, 1921		4,932

TABLE No. 2.—*Statement showing amounts in cubic meters of important timbers, by species cut and invoiced in the Philippine Islands during the fiscal years 1910 to 1921*

Species.	Fiscal year—				July 1 to December 31, 1913.
	1910	1911	1912	1913	
Red lauan	....	....	....	....	....
White lauan	43,439	46,942	57,036	81,469	20,249
Apitong	20,764	21,096	28,929	32,391	12,905
Tangile	2,106	2,762	3,999	5,249	3,390
Guijo	14,107	14,231	18,579	17,279	7,841
Yakal	8,225	8,150	14,491	21,770	5,593
Ipil	13,717	12,296	17,237	15,791	7,535
Molave	8,923	7,978	9,091	9,363	4,783
Narra	5,744	4,996	8,474	8,877	3,941
Kalantas	3,174	1,368	988	3,320	886
Palosapis	....	....	....	....	....
Mangachapuy	....	....	....	....	....
Dungon	2,453	1,693	1,218	931	601
Tindalo	954	1,018	794	932	484
Akle	809	867	1,295	1,690	729
Lumbayao	....	....	....	....	....
Pagatpat	....	....	....	....	....
Other species:					
First group	574	322	707	1,000	687
Second group	6,667	6,644	7,988	8,543	3,266
Third group	8,316	10,927	11,796	8,711	2,999
Fourth group	36,786	41,655	42,981	59,855	25,613
Total	176,758	182,945	225,548	277,171	101,502

	Fiscal year—				
	1914	1915	1916	1917	1918
Red lauan	....	....	....	....	....
White lauan	74,453	73,277	107,684	131,699	108,900
Apitong	32,328	38,849	52,529	55,335	56,274
Tangile	14,682	15,460	28,961	25,389	21,775
Guijo	19,701	15,650	16,685	16,857	17,301
Yakal	15,115	14,714	16,471	11,963	9,162
Ipil	17,602	12,089	14,147	16,629	15,498
Molave	9,753	10,546	10,788	13,582	22,233
Narra	8,467	9,868	7,970	5,904	7,848
Kalantas	2,423	1,999	4,574	7,381	4,975
Palosapis	2,222	1,631	2,723	3,042	8,863
Mangachapuy	1,469	1,859	2,666	2,916	2,214
Dungon	2,199	1,467	1,127	1,592	1,318
Tindalo	914	1,181	1,115	1,145	826
Akle	1,287	1,498	1,088	798	870
Lumbayao	....	....	....	6,085	4,415
Pagatpat	....	....	....	1,502	849
Other species:					
First group	2,196	2,190	3,074	1,084	1,416
Second group	9,373	6,940	7,938	6,432	7,779
Third group	7,557	6,920	5,214	9,895	8,611
Fourth group	73,017	60,130	56,738	47,661	80,933
Total	294,758	276,268	341,442	366,891	382,060

TABLE NO. 2.—*Statement showing amounts in cubic meters of important timbers, by species cut and invoiced in the Philippine Islands during the fiscal years 1910 to 1921*—Continued.

Species.	Fiscal year—			Total, 1910 to 1921.
	1919	1920	1921	
Red lauan	....	52,294	72,986	125,280
White lauan	180,556	119,833	125,586	1,171,023
Apitong	72,223	99,775	99,652	623,050
Tangile	85,005	40,903	47,311	246,992
Guijo	25,924	28,413	30,625	243,220
Yakal	11,100	20,317	28,245	192,316
Ipil	18,926	24,720	28,556	214,743
Molave	26,088	30,173	31,826	195,127
Narra	11,152	12,711	16,164	112,116
Kalantas	5,040	8,622	5,350	50,050
Palosapis	15,661	7,594	5,928	47,664
Mangachapuy	8,096	3,094	4,340	21,654
Dungon	1,839	2,607	2,726	21,766
Tindalo	1,080	1,887	2,404	14,284
Akle	987	2,047	1,553	15,468
Lumbayao	4,192	7,550	8,179	80,421
Pagatpat	2,766	4,743	5,454	15,314
Other species:				
First group	3,335	9,104	17,352	43,041
Second group	12,084	17,414	29,304	130,372
Third group	53,513	1,978	15,258	151,690
Fourth group	3,711	59,718	75,173	663,971
Total	495,228	554,997	653,944	4,329,512

NOTE.—Figures after white lauan, from 1910 to 1919, represent both lauans. It will be noted from the above that the separation was only made during 1920.

TABLE NO. 3.—*Revenues from sale of forest products, January 1 to December 31, 1921*

Province.	Charges on forest products.								Total.
	Timber.				Firewood.		Minor products.	Lease of forest lands.	
	First group, ₱2.50 per cubic meter.	Second group, ₱1.50 per cubic meter.	Third group, ₱1 per cubic meter.	Fourth group, ₱0.50 per cubic meter.	Bacauan and tangal, ₱0.20 per cubic meter.	Others, ₱0.10 per cubic meter.			
Abra	₱2,918.88	₱1,146.31	₱535.94	₱136.68	₱57.50	₱145.31	₱331.40	....	₱5,272.02
Agusan	3,872.91	188.61	276.46	128.29	12.35	11.80	938.42	....	5,428.84
Albay	9,254.09	2,619.21	2,345.31	647.34	273.86	257.01	5,587.67	....	20,984.49
Antique	682.53	65.42	166.79	36.99	8.40	10.19	316.93	....	1,287.25
Bataan	209.86	1,607.86	4,681.16	4,332.29	401.50	827.99	2,184.57	....	14,245.23
Batangas	1,899.73	1,442.72	79.16	64.80	37.91	282.17	1,351.83	₱1.00	5,159.32
Bohol	1,790.67	216.17	80.58	468.07	887.27	1,317.82	792.56	....	5,552.64
Bukidnon	253.63	43.11	9.12	10.85	61.72	40.30	203.35	....	622.08
Bulacan	1,074.96	923.89	1,197.39	780.98	368.55	69.88	1,001.32	....	5,416.97
Cagayan	9,834.22	1,369.09	3,332.96	622.75	265.42	280.95	5,066.77	12.50	20,784.66
Camarines Norte	545.61	318.50	654.57	368.33	346.93	33.64	2,477.50	....	4,745.08
Camarines Sur	1,573.18	1,337.87	1,832.70	875.01	102.60	213.56	4,722.79	....	10,657.71
Capiz	432.40	162.86	1,608.60	1,449.66	4,201.94	461.57	1,128.63	....	9,445.66
Cavite	21.96	3.19	.54	.36	4.42	133.97	688.23	....	852.67
Cebu	2,091.09	303.27	1,210.25	1,517.26	3,396.99	1,039.51	562.95	61.31	10,182.63
Cotabato	12,161.96	5,875.97	3,321.95	6,278.15	1,289.07	104.35	1,114.70	....	30,146.15
Davao	1,814.39	696.96	608.81	2,693.21	319.17	163.08	5,269.94	....	11,565.56
Ilocos Norte	1,641.57	842.74	298.59	125.85	20.70	56.25	142.44	....	3,128.14
Ilocos Sur	526.54	268.08	64.78	66.76	18.20	57.20	244.27	....	1,245.83
Iloilo	16,285.75	2,833.30	1,469.45	1,144.19	1,151.00	1,926.76	2,317.66	....	27,128.11
Isabela	5,022.08	1,775.78	921.50	372.66	33.57	75.89	248.28	....	8,449.71
Laguna	164.88	661.72	1,106.55	433.58	2.13	113.70	1,109.02	....	3,591.58
Lanao	483.23	89.12	176.71	83.32	....	33.57	111.98	....	977.93
La Union	509.59	258.99	56.84	82.07	6.55	.05	109.39	2.00	1,025.48
Leyte	6,399.01	1,155.23	7,385.23	2,932.13	1,224.82	106.43	3,562.46	....	22,764.81
Manila	85,672.49	21,619.50	159,143.22	64,594.52	1,676.42	3,985.08	5,915.75	111 00	342,717.98
Marinduque	169.48	122.54	71.31	40.17	118.92	103.38	300.96	....	926.76
Masbate	10,285.72	857.87	408.74	1,269.05	439.22	170.33	1,578.28	131.00	15,140.21
Mindoro	1,392.16	917.51	864.45	1,177.04	607.74	179.56	3,522.64	....	8,661.10
Misamis	1,522.25	1,101.89	1,871.03	1,092.43	47.14	231.55	867.91	....	6,734.20
Mountain	819.04	1,455.82	6,653.75	455.34	72.08	728.55	789.60	....	10,974.18
Nueva Ecija	3,555.90	1,230.75	43.84	93.45	6.72	285.46	2,787.87	....	8,003.49
Nueva Vizcaya	727.65	54.00	18.12	5.47	5.80	100.49	96.28	....	1,007.81
Occidental Negros	1,714.26	389.44	414.95	461.29	204.24	380.34	7,161.75	....	10,776.27
Oriental Negros	7,669.54	2,879.01	2,689.32	2,361.26	719.78	777.52	4,779.50	....	21,875.88
Palawan	3,684.61	165.47	30.66	208.15	145.48	67.78	3,490.46	....	7,792.53
Pampanga	105.58	1,254.14	813.43	237.36	129.05	1,538.49	927.96	....	5,006.01

Pangasinan	5,590.04	3,172.42	1,609.90	469.68	1,113.83	442.78	1,700.00	....	14,098.65
Rizal	226.77	238.78	137.05	312.59	16.78	524.27	1,607.32	....	3,063.56
Romblon	1,762.41	6,816.63	310.78	118.45	35.50	99.28	1,082.51	....	10,225.56
Samar	7,473.18	1,213.39	1,772.18	775.60	375.19	764.36	4,444.69	....	16,818.59
Sorsogon	9,038.26	2,993.65	1,164.67	1,196.28	1,261.90	159.97	2,328.10	66.00	18,208.83
Sulu	9,215.04	657.92	1,294.17	254.61	925.00	....	1,364.18	....	13,710.92
Surigao	2,084.35	362.63	476.55	99.76	561.04	13.53	5,147.91	....	8,745.77
Tarlac	536.46	226.87	55.24	50.66	3.10	98.57	1,049.46	....	2,020.36
Tayabas	29,840.91	3,472.58	3,122.88	1,720.62	6,067.06	3,440.51	13,920.49	51.15	61,636.20
Zambales	1,615.30	1,714.47	2,087.20	651.80	532.16	536.88	1,831.02	....	8,968.83
Zamboanga	17,912.95	9,373.87	42,422.04	14,534.84	3,133.75	801.44	7,262.53	....	95,441.42
Total charges	284,079.02	88,447.12	260,896.92	117,932.00	32,689.92	23,192.49	115,542.23	435.96	923,215.66
Total fines and penalties	32,632.25	11,414.72	11,599.75	11,013.80	3,249.89	4,309.17	15,715.92	....	89,935.50
Grand total	316,711.27	99,861.84	272,496.67	128,945.80	35,939.81	27,501.66	131,258.15	435.96	1,013,151.16

TABLE NO. 4.—*Timber licenses issued during the fiscal year 1921 (January 1 to December 31)*

Province.	For less than 100 cubic meters.	For 100 cubic meters and less than 1,000 cubic meters.	For 1,000 cubic meters and over.	License agreements	Total commercial licenses.	For personal use.		For public works.	Miner's gratuitous licenses.	Total.
						Inside communal forests.	Outside communal forests.			
Abra	42	51	....	....	93	13	8	2	....	23
Agusan	8	1	2	....	11	4	59	2	1	66
Albay	8	20	13	....	41	77	29	....	....	106
Antique	11	4	....	....	15	3	5	2	....	10
Bataan	11	14	38	2	65	....	....	2	....	2
Batangas	5	8	....	....	13	1	4	3	....	8
Bohol	14	7	....	....	21	161	4	2	....	167
Bukidnon	....	1	3	....	4	....	8	2	....	10
Bulacan	10	52	9	....	71	....	5	2	9	16
Cagayan	10	81	15	....	106	27	34	2	1	64
Camarines Norte	5	14	4	....	23	....	3	2	15	20
Camarines Sur	22	24	4	1	51	22	9	2	....	33
Capiz	31	44	1	....	76	18	1	2	....	21
Cavite	1	....	....	....	1	....	....	2	....	2
Cebu	30	16	2	....	48	23	38	3	5	69
Cotabato	5	2	2	....	9	....	....	2	....	2
Davao	23	31	21	....	75	1	64	2	....	67
Ilocos Norte	38	31	5	....	74	42	2	3	....	47
Ilocos Sur	30	1	....	....	31	32	12	5	....	49
Iloilo	19	21	1	....	41	....	2	2	....	4
Isabela	34	30	3	....	67	150	2	2	....	154
Laguna	22	30	3	....	55	....	1	2	....	3
Lanao	3	....	2	1	6	2	....	2	....	4
La Union	19	4	....	....	23	25	2	3	....	30
Leyte	40	51	9	....	100	211	219	3	....	433
Marinduque	2	9	1	....	12	....	....	....	....	....
Masbate	8	35	18	2	63	14	23	....	8	45
Mindoro	11	50	28	....	89	4	8	2	....	14
Misamis	6	11	1	....	18	138	10	2	....	150
Mountain Province	52	36	5	1	94	4	13	3	3	23
Nueva Ecija	15	22	1	....	38	58	14	2	....	74
Nueva Vizcaya	22	5	2	....	29	29	11	2	....	42
Occidental Negros	8	37	23	2	70	4	....	2	....	6
Oriental Negros	6	8	3	....	17	8	17	3	....	28
Palawan	11	5	35	....	51	....	25	2	....	27
Pampanga	....	14	4	....	18	....	....	2	....	2
Pangasinan	24	66	11	....	101	133	3	2	7	145
Rizal	9	13	1	....	23	....	....	2	....	2
Romblon	2	9	4	....	15	5	12	2	....	19
Samar	91	50	8	....	149	278	33	2	....	313
Sorsogon	11	25	5	....	41	....	1	2	....	3

Sulu		2	6		8			2		2
Surigao	42	11	3		56	88	106	2	2	198
Tarlac	4	13	2		19	86	6	2		94
Tayabas	16	83	71	1	171	24	3	3	6	36
Zambales	10	26	13		49	62		2		64
Zamboanga	16	16	21	5	58	49	50	2		101
All provinces								1		1
Total	807	1,084	403	15	2,309	1,796	846	100	57	2,799
Total 1920	534	1,470	473	15	2,493	1,481	1,045	108	63	2,692
Difference	+273	—386	—70		—184	+315	—199	—3	—6	—107

NOTE.— + = increase; — = decrease.

In the Provinces of Cagayan, Isabela, Abra, La Union, and Mountain Province, 378 licenses were issued for building tobacco curing-houses.

TABLE NO. 5.—*Statement of forest products, cut or gathered from registered private woodlands during the fiscal year 1921*

Province.	Timber.					Firewood.		Char-coal.	Tan-bark.	Split rattan.	Diliman.	Daluru.	Buri.	White earth balls.
	First group.	Second group.	Third group.	Fourth group.	Total.	First class.	Second class.							
	Cu. m.	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Kilos.*	*Kilos.*	*Kilos.*	*Cu. m.*	*Kilos.*	*Number.*
Bataan	1	16	58	43	118	100	33	88			880			
Batangas	20	98		224	342				2,850					
Bulacan						1,320	50							
Cagayan	14				14									
Cavite								60						
Iloilo							361	32						
Laguna							1,372	3,498					16	1,200
Masbate	51				51									
Mindoro	33	4			37	20								
Nueva Ecija							377							
Occidental Negros	94				94									
Oriental Negros	44	122	169	176	511									
Pampanga						11,802	2,771	106				4		
Rizal	101	7	12	149	269	6	3,791							
Romblon	149	202	8		359									
Sorsogon	345				345									
Tarlac	37	56	14	45	152		3,740			1,000				
Tayabas								83						
Zambales							392							
Total	889	505	261	637	2,292	13,248	12,887	3,867	2,850	1,000	880	4	16	1,200

TABLE NO. 6.—*Minor products licenses issued during the fiscal year 1921 (January 1 to December 31)*

Province.	Firewood.	Charcoal.	Dye wood.	Tanbarks and dyebark.	Wood oils.	Almaciga, resins, and others.	Gutta-percha.	Rattan and diliman.	Gogo.	Sand, gravel, and stone.	Others.	Total.
Abra	18							16		1	1	36
Agusan	5	1				1		34				41
Albay	37			3		1		38			2	81
Antique	1					1		20				22
Bataan	34	16			1	4		70	17		1	143
Batangas	10			8				2			9	29
Bohol	27										2	29
Bukidnon	2						1	12				15
Bulacan	4	15		1		2		30	3			55
Cagayan	26			2	1	6		90			1	126
Camarines Norte	6			1		1		13			4	25

Camarines Sur	43	2	......	8	1	30	......	627	2	2	2	717
Capiz	54	5	......	3	......	......	......	11	2	......	5	80
Cavite	7	1	......	2	......	......	......	......	9	......	......	19
Cebu	90	2	......	......	......	......	......	4	1	......	25	122
Cotabato	10	......	1	2	......	2	9	6	2	......	12	44
Davao	36	5	1	......	......	12	......	12	......	2	18	86
Ilocos Norte	14	......	......	2	......	......	......	7	1	......	3	27
Ilocos Sur	6	......	......	1	......	......	......	......	......	3	24	34
Iloilo	91	12	21	11	2	......	......	16	......	......	9	162
Isabela	11	......	......	......	......	1	......	27	......	......	......	39
Laguna	11	6	......	3	......	1	......	27	12	......	20	80
Lanao	6	......	......	1	......	......	2	11	......	......	8	28
Leyte	42	2	......	1	5	......	......	35	......	15	2	102
Marinduque	9	......	......	7	......	4	......	12	1	......	1	34
Masbate	26	......	......	12	......	1	......	45	3	......	2	89
Mindoro	48	1	......	29	......	4	......	103	27	......	9	221
Misamis	17	......	......	1	......	1	......	19	......	......	5	43
Mountain Province	24	4	......	2	1	......	......	31	......	10	8	80
Nueva Ecija	13	1	......	......	......	3	......	48	39	......	16	120
Nueva Vizcaya	5	......	......	......	......	......	......	18	......	......	......	23
Occidental Negros	60	......	......	3	16	2	......	200	39	1	12	333
Oriental Negros	15	......	......	......	9	......	......	36	6	......	2	68
Palawan	52	......	......	59	4	32	......	44	12	......	13	216
Pampanga	12	4	......	......	......	......	......	10	5	......	3	34
Pangasinan	38	1	1	24	......	......	......	8	8	......	5	85
Rizal	38	12	......	4	......	2	......	16	10	......	3	85
Romblon	4	......	......	2	9	10	......	5	1	......	3	34
Samar	34	......	......	5	4	1	......	90	......	......	1	135
Sorsogon	32	......	......	5	4	2	......	18	......	......	......	61
Sulu	2	1	......	1	......	......	......	......	......	......	......	4
Surigao	21	4	......	7	2	1	......	25	......	4	......	64
Tarlac	11	3	......	3	......	1	......	13	11	......	4	46
Tayabas	100	14	1	34	3	113	......	130	17	5	38	455
Zambales	46	7	......	8	......	5	......	36	9	......	8	119
Zamboanga	37	11	......	12	......	13	12	50	......	......	9	144
Total	1,230	130	25	267	62	257	24	2,065	237	43	295	4,635
Total (1920)	1,194	108	27	188	72	248	33	1,646	165	64	166	3,911
Difference	+36	+22	—2	+79	—10	+9	—9	+419	+72	—21	+129	+724

NOTE.—+ = increase; — = decrease.

TABLE NO. 6-A.—*Report of utilization of forest products from public forest of the Philippine Islands during the fiscal year 1921 (January 1 to December 31)*

Province.	Timber.					Firewood.		Charcoal.	Dyewood.	Tanbark.
	First group.	Second group.	Third group.	Fourth group.	Total.	First class.	Second class.			
	Cu. m.	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Cu. m.*	*Kilos.*	*Kilos.*
Abra	1,493	677	782	379	3,481		3,064			
Agusan	3,347	293	175	185	4,000	62	9	4		
Albay	5,428	2,441	3,310	1,619	12,798	968	2,401			4,785
Antique	1,010	237	299	109	1,655	42				
Bataan	77	6,113	46,387	22,427	75,004	1,903	14,520	946		
Batangas	196	67	16	72	351	40	2,518	36		38,898
Bohol	1,049	472	304	596	2,421	21,396	15,837	8		3,248
Bukidnon	10	8	8	16	42					
Bulacan	709	1,366	2,453	2,232	6,760	665	1,321	1,006		1,138
Cagayan	5,812	794	3,115	931	10,652	1,315	3,963			10,580
Camarines Norte	475	645	2,307	1,161	4,598	1,720	1,726			29,240
Camarines Sur	2,379	3,546	11,505	5,107	22,537	940	2,221			75,515
Capiz	180	182	2,405	2,559	5,226	22,447	7,867	431		14,565
Cavite		21	4		25		1,506	36		800
Cebu	295	135	378	502	1,310	387	10,309	15		4,903
Cotabato	5,335	4,751	3,988	7,810	21,884	1,631	9,613			801
Davao	902	871	1,201	4,157	7,131	1,460	239	166		1,659
Ilocos Norte	743	441	316	389	1,889	40	849			3,806
Ilocos Sur	280	42	74	55	451		522			2,840
Iloilo	423	1,308	680	871	3,282	5,524	21,672	291	25,069	288,271
Isabela	2,695	1,548	1,504	727	6,474	5	377			
Laguna	51	673	1,741	1,035	3,500	2	1,875	525		1,525
Lanao	386	693	34,442	15,077	50,598	20	308			280
La Union	244	216	74	84	618		80			9,500
Leyte	3,835	915	6,503	3,807	15,060	4,664	806	11		1,212
Marinduque	89	208	111	79	487	5,831	3,678		1,800	
Masbate	9,968	3,467	1,769	3,014	18,218	1,824	4,149	35		75,461
Mindoro	2,012	4,143	2,449	4,435	13,039	10,779	1,841	13		78,180
Misamis	533	462	14,394	1,869	17,258	255	2,198			916
Mountain Province	1,006	509	6,986	1,982	10,483		19,035	5		
Occidental Negros	2,731	2,928	40,044	73,049	118,752	6,581	6,849			3,681
Oriental Negros	912	498	319	1,163	2,892	248	3,523			5,870
Nueva Ecija	1,721	875	139	126	2,861		3,348	28		3,740
Nueva Vizcaya	315	118	85	10	528		856			3,875
Palawan	27,830	456	52	304	28,642	706	143			172,911
Pampanga	188	813	3,599	3,545	8,145	1,507	13,803	221		4,457
Pangasinan	3,034	2,889	2,274	1,501	9,698	7,487	3,368	88		273,021
Rizal	93	205	176	711	1,185	82	16,380	272		526
Romblon	1,047	5,267	407	59	6,780	20	81			

Samar	3,080	1,424	3,897	3,409	12,560	4,887	260	...	...	194,040
Sorsogon	8,665	1,117	1,108	1,865	12,755	5,034	1,008	7	...	5,848
Sulu	4,196	1,028	1,512	706	7,437	8,442	311	894	...	168,045
Surigao	1,335	235	157	231	1,958	2,027	785	3	1,800	112,845
Tarlac	500	147	85	122	824	...	3,390	427	...	2,094
Tayabas	17,004	3,787	22,502	6,181	49,427	29,983	33,045	1,726	...	155,524
Zambales	1,291	1,410	3,430	2,229	8,360	2,424	7,823	65	...	2,840
Zamboanga	5,846	6,426	25,374	22,262	59,908	9,378	14,240	25	...	593,504
Total	181,450	67,022	254,763	200,709	653,944	157,259	243,667	7,284	38,167	2,299,894
Total (1920)	109,081	51,528	214,837	179,551	554,997	597,787	259,294	8,129	1,049,467	1,157,575
Difference	+22,369	+15,494	+39,926	+21,158	+98,947	—440,528	—15,627	—845	—1,011,298	+1,142,319

Province.	Wood oils.	Copal gum.	Daluru.	Gutta-percha	Split rattan.	Unsplit rattan.		Diliman.	Limestone.	Gogo.
						Over 2 centimeters in diameter.	Two centimeters in diameter or less.			
	Liters.	*Kilos.*	*Cu. m.*	*Kilos.*	*Kilos.*	*Lin. m.*	*Lin. m.*	*Kilos.*	*Kilos.*	*Kilos.*
Abra	...	...	...	...	...	44,500	381,352	...	50,000	...
Agusan	...	...	...	...	70,555	1,280	18,180	2,226	...	...
Albay	...	200	...	...	280,983	1,170	...	726	...	...
Antique	...	...	...	...	18,040	...	...	2,828	...	...
Bataan	...	...	...	...	67,087	89,390	91,750	2,106	...	1,808
Batangas	...	...	...	...	442	...	1,250	327	35,000	22,271
Bohol	294	...	...	...	427	...	...	630	...	117
Bukidnon	...	300	...	600	15,618	...	...	...	...	...
Bulacan	...	40	...	...	12,125	50,050	785,940	...	...	42
Cagayan	...	...	...	...	215,679	96,810	96,164	...	...	...
Camarines Norte	...	...	...	...	181,961	...	24,410	1,767	7,000	...
Camarines Sur	...	129,891	...	...	204,119	45,720	208,385	1,001	...	...
Capiz	...	...	...	...	7,195	12,000	8,228	1,193	...	...
Cavite	...	...	...	...	...	...	...	...	...	28,915
Cebu	...	...	...	...	2,313	...	...	4,164	...	1,380
Cotabato	...	...	...	34,938	268	...	17,250	...	...	...
Davao	1,304	299,896	...	...	6,823	38	52,985	1,179	...	...
Ilocos Norte	...	...	...	...	3,167	...	...	...	20,000	120
Ilocos Sur	...	...	...	...	2,400	...	...	...	63,942	...
Iloilo	...	...	1	...	4,267	...	5,000	2,880	...	195
Isabela	...	...	...	...	...	34,040	67,949	...	...	...
Laguna	...	...	...	...	23,558	...	9,811	5,476	699	...
Lanao	...	...	...	...	1,218	...	...	2,547	...	...
La Union	...	...	...	...	...	...	...	...	...	...
Leyte	32,578	...	...	...	78,122	139,552	159,869	68,357	...	82
Marinduque	...	...	...	...	5,335	...	1,617	11,162	...	...
Masbate	...	...	...	...	60,302	...	...	7,340	...	1,963
Mindoro	...	...	...	...	75,512	10,551	131,160	40,081	...	4,177
Misamis	...	743	10	...	31,997	2,060	12,600	...	...	...

TABLE NO. 6–A.—*Report of utilization of forest products from public forest of the Philippine Islands during the fiscal year 1921 (January 1 to December 31)*

Province.	Wood oils.	Copal gum.	Daluru.	Gutta-percha	Split rattan.	Unsplit rattan. Over 2 centimeters in diameter.	Unsplit rattan. Two centimeters in diameter or less.	Diliman.	Limestone.	Gogo.
	Liters.	*Kilos.*	*Cu. m.*	*Kilos.*	*Kilos.*	*Lin. m.*	*Lin m.*	*Kilos.*	*Kilos.*	*Kilos.*
Mountain Province					117,457	71,120	8,500		135,989	
Nueva Ecija					40,044	18,772	564,630	1,199		11,649
Nueva Vizcaya					50		38,440			
Occidental Negros	7,764				251,125	7,168	11,195	10,952		9,242
Oriental Negros	63,976				303,517		8,370	3,060		16,686
Palawan	360	68,008			3,227		275,500			16,288
Pampanga			173		4,541		62	399		1,016
Pangasinan			47		1		13,200			2,540
Rizal					15,275			300		226
Romblon	3,971	14,103			1,460			30		38
Samar	1,210	34			215,611	5,850	25,180	18,209		
Sorsogon	46,536	2,971			22,041					218
Sulu		20			2,101					
Surigao	565				409,968					
Tarlac					27,407	4,010	275,925	125		8,542
Tayabas		63,819			385,666	1,030,593	2,056,760	25,804		111
Zambales		752			14,680	95,500	1,709,438			10,270
Zamboanga		8,760	300	5,783	42,362	4,964	1,577	871		
Total	158,558	589,587	581	41,271	3,170,481	1,765,138	7,002,622	216,439	312,630	137,836
Total (1920)	52,850	1,841,396	263	356,568	2,153,025	4,389,114	2,716,587	109,963	458,645	126,198
Difference	+105,708	—1,251,859	+268	—315,297	+1,017,456	—2,623,976	+4,286,035	+106,476	+146,015	+11,638

Province.	Stone, sand, and gravel.	Buri.	Guano.	Salago bark.	Nipa.	Dye bark.	Cabonegro.	Other vines for tying.	Gum elemi.	Fern trees.	Bees wax.
	Kilos.	*Kilos.*	*Kilos.*	*Kilos.*	*Shingles.*	*Kilos.*	*Kilos.*	*Kilos.*	*Kilos.*	*No.*	*Kilos.*
Abra											
Agusan					10,035						
Albay						531					
Antique											
Bataan											
Batangas		22,425					776				
Bohol											
Bukidnon											

Bulacan										
Cagayan										
Camarines Norte										
Camarines Sur						6,250					
Capiz		8,171	2,000			2,455					
Cavite											
Cebu		24,898									
Cotabato					250				165		6,933
Davao											44
Ilocos Norte						4,050					
Ilocos Sur	32,240										
Iloilo			50,564								
Isabela											
Laguna	251						15,691	14,486			
Lanao					5,150						90
La Union											
Leyte	144										
Marinduque		4,093				8,970					
Masbate		9,160							2,300		
Mindoro		19,084		350		22,003					
Misamis									50		
Mountain Province	54									26	2
Occidental Negros			1,711								
Oriental Negros											
Nueva Ecija		87,018				99					
Nueva Vizcaya											
Palawan						66,701					481
Pampanga	1	50,922									
Pangasinan		6,725				1,366					
Rizal						920		3,522			
Romblon		26,309									
Samar						933					
Sorsogon						13,369			33		
Sulu											
Surigao	29										
Tarlac		6,490									
Tayabas	491	347,511				604	1,496	2,608	69,038		
Zambales					102,800	318					
Zamboanga											251
Total	33,210	607,806	54,275	350	117,735	128,569	17,963	20,616	71,586	26	7,801
Total (1920)	51,818	985,889	216		11,800	75,747	120				
Difference	—18,608	—378,083	+54,059	+350	+105,935	+52,822	+17,843	+20,616	+71,586	+26	+7,801

NOTE.—+ = increase; — = decrease.

TABLE NO. 7.—*Statement showing the quantity and value of minor forest products exported during the fiscal year 1921 (January 1 to December 31)*

	Kilos.	Value.
Copal (almáciga):		
United States	135,495	₱25,154
United Kingdom	85,314	10,808
France	2,611	1,800
Germany	180	70
British East Indies	63,758	11,277
Japan	250,949	90,165
Australasia	4,393	1,333
Total	542,700	140,607
Elemi (pili resin):		
United States	23,797	5,620
Germany	4,985	1,994
Japan	195	75
Total	28,977	7,689
Gutta-percha:		
United States	1,054	550
United Kingdom	13,756	12,916
Total	14,810	13,466
Rubber:		
United States	22,330	16,000
British East Indies	18,297	9,700
Total	40,627	25,700
Lumbang (candle nut) oil:		
Spain	45	11
China	370	150
Total	415	161
Sappan wood (sibukao):		
China	190,395	5,361
Hongkong	12,650	420
Total	203,045	5,781
Grand total	....	193,404

TABLE NO. 8.—*Statement of appropriation and expenditures, Bureau of Forestry (January 1 to December 31, 1921).*

Appropriation:		
Act No. 2935		₱589,745.00
Resolution No. 147		1,700.00
		591,445.00
Less reductions:		
Resolution No. 37	₱22,927.00	
Resolution No. 59	15,137.00	
		38,064.00
Total appropriation		553,381.00
Expenditures:		
Salaries and wages	332,539.22	
Bonus	43,634.40	
Traveling expenses of personnel	69,031.44	
Freight, express and delivery service	3,056.54	
Postal, telegraph and cable service	11,065.71	
Illumination and power service	4,440.63	
Miscellaneous services	1,530.20	
Rentals of buildings and grounds	10,016.43	
Consumption of supplies and materials	37,649.10	
Printing and binding report	3,624.73	
Traveling expenses not government employees	300.00	
Maintenance and repair	1,961.22	
Furniture and office equipment	6,071.90	
Total expenditures		524,921.52
Balance, January 1, 1922		28,459.48
Appropriation for construction of a fire-proof vault (Act No. 2786):		
Balance, January 1, 1921		2,016.88
Expenditures		....
Balance, January 1, 1922		2,016.88
Appropriation for purchase and installation of a still-for-water, Los Baños (Act No. 2898):		
Balance, January 1, 1921		1,475.11
Expenditures		1,474.18
Balance, January 1, 1922		.93
Statement of the Bureau of Forestry appropriation, expenditures and revenues for the fiscal year 1921:		
Appropriation		553,381.00
Revenue		1,013,151.16
Expenditures		524,921.52
Surplus		488,229.64
Percentage of expenditures to revenue		51%

TABLE NO. 9.—*Revenues derived from the sale of forest products and expenditures of the Bureau of Forestry since its organization, April 14, 1900*

Fiscal year.	Revenue.	Expense.	Surplus.	Expenses.
				Per cent.
1901 to 1906[a]	₱2,268,591	₱1,118,887	₱1,149,704	49
1907	191,080	105,050	86,080	55
1908	211,571	107,242	104,329	51
1909	251,380	115,049	136,331	45
1910	271,582	152,161	119,421	56
1911	334,763	160,476	174,287	48
1912	354,685	200,840	153,845	57
1913[a]	390,664	227,048	163,616	59
1913 (July 1 to December 31)	160,913	141,131	19,782	88
1914	442,661	256,990	185,671	58
1915	425,817	274,176	151,641	64
1916	494,447	285,708	208,739	58
1917	536,328	281,126	255,202	53
1918	650,692	334,254	316,438	51
1919	805,229	473,242	331,986	58
1920	1,009,879	541,488	468,390	54
1921	1,013,151	524,921	488,230	51
Total	9,813,483	5,299,789	4,518,642	54

[a] Up to 1913, the fiscal year was from July 1 to June 30.

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